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HUSSEY (N.W.) & WYATT (I.J.). **Preliminary Observations on the Cecid Problem.** — *MGA Bull.* no. 100 pp. 150–158, 5 figs., 17 refs. London, 1958.

Damage to mushroom crops by Cecidomyiids has become increasingly important in Britain of recent years; 46 per cent. of the growers who replied to a questionnaire in 1956 reported damage of this type, and 21 per cent. reported reduced cropping in consequence. Investigations were accordingly begun in southern England in January 1957, and in this paper, which was read at a conference, an account, based on the findings and on the literature [*cf. R.A.E.*, A **22** 513, etc.], is given of the bionomics of the species concerned. The commonest appears to be *Heteropeza pygmaea* Winn., which is recorded from mushroom compost in England and Scotland and has been found in both unspawned and spent compost and in a humic soil. *Mycophila barnesi* Edw. and *M. speyeri* (Barnes) have both been recorded from mushrooms in various parts of England, and the former also from garden manure, mushroom manure, rotting potatoes and peat for casing. A fourth species, *Lestremia cinerea* Macq., occasionally attacks mushrooms. A key for the separation of the adults of *H. pygmaea* and the two species of *Mycophila* is given. The larvae reproduce paedogenetically [*cf.* **16** 615], and the paedogenetic larvae of *Heteropeza* and *Mycophila* spp. cannot be differentiated. Sexual larvae are produced occasionally, and these pupate and give rise to adults; characters differentiating sexual larvae of the two genera are described. The occurrence of adults appears to be governed largely by environmental factors, and E. Gabritschevsky showed that in the closely related genus, *Miastor*, which is occasionally associated with mushrooms in the United States, sexual larvae and orange larvae with hypertrophied eyes and strong migratory instincts became more numerous than paedogenetic, white larvae beneath the bark of tree trunks as the habitat became progressively drier and less favourable for fungus growth; the orange larvae were almost the only ones present in mid-winter.

The bionomics of *H. pygmaea* were studied in stocks derived from larvae that had been externally sterilised in 5 per cent. formalin [formaldehyde] and were reared in cultures of pure mushroom mycelium. Under these conditions, the paedogenetic larvae each gave rise to an average of 7–8 daughter larvae. Paedogenetic larvae are normally produced indefinitely under optimum conditions of food and environment and a temperature of about 84° F. When conditions favour the production of adults, a special type of paedogenetic larva appears and produces 3–5 sexual larvae that give rise to adults about five days after pupation. The very high larval populations that develop in the compost normally remain below the surface, but the larvae often swarm on the casing following watering, although they can survive submergence for several days. The importance of the Cecidomyiids seems to have increased since the use of peat for casing became widespread, and, in the few outbreaks studied, infestation appeared first in the compost but was later confined almost entirely to nodules of peat in the casing. The larvae can complete their life-cycle on the mycelium and almost certainly cause most damage in this manner. They also attack the fructifications, burrowing into the stems, which show discoloured, slimy streaks, often with a shredded appearance, and causing the gills to wither; a bacterial slime is sometimes associated with the latter damage. Larvae in abundance are often associated with bacterial pit disease, and since unsterilised larvae leave strong bacterial trails on agar plates, they probably spread, and may introduce it.

The Cecidomyiids are difficult to kill in the larval stage, though the adults readily succumb to insecticides, and control would therefore be

facilitated if paedogenesis could be terminated. It has been suggested that light, crowding and poor nutrition initiate the production of pupae, and it was confirmed that sexual larvae in crowded cultures reverted to paedogenesis if transferred to fresh cultures before reaching a certain developmental stage. In cultures that were starved slowly, most larvae became of the sexual type, whereas a rapid change from abundant food to starvation levels caused them to become quiescent or die, with the development of few sexual larvae. In investigations of the effect of heat, the thermal death-point was reached at 99 and 113° F., respectively, for larvae of *M. barnesi* and *H. pygmaea* that were exposed in vials in a thermostatically controlled water bath for one hour. When paedogenetic larvae of *H. pygmaea* were reared at constant temperatures, the average duration of a generation was reduced from 9.5 days at 69.8° F. to 8.1 at 85.1° F. and the number of offspring per parent from 10.2 to 7. Some colonies developed very rapidly and others became senescent at the higher temperatures, the effects of which were probably produced indirectly through retardation of the growth of the mycelium.

Infestations are unlikely to be initiated from the compost, since no larvae were reared from fresh compost or horse manure, and little compost can fail to reach a temperature of 110° F. during the heating process. The occurrence of *M. barnesi* and *H. pygmaea* in peat and peaty soil, respectively, indicates that unsterilised casing is a probably source of infestation, and since B. D. Moreton reports that larvae of *H. pygmaea* can burrow into the bed-boards for up to ½ in., survival would be ensured. P. N. Heron successfully controlled infestation by treating the boards with sodium pentachlorophenate, which destroys wood-rotting fungi, though it also causes some direct mortality. Infestation by any species may be initiated by adult flight; adults of *H. pygmaea* were trapped at light only 11 days after peak heating of the compost, from which it is unlikely that they could have emerged. Infestation is at times very localised, and one very local and severe infestation occurred near decaying elder (*Sambucus nigra*). Spent compost, which usually contains numerous larvae, is a possible source. Answers to the questionnaire indicated that infestation was heavier in crops grown on shelves than in those on trays, owing to the shorter cropping period of the latter, that composting methods did not affect incidence, and that infestation was commoner when the compost was allowed to heat to temperatures above 130° F. than when the temperature was limited to 130° F. The greater incidence under the former conditions is attributed to the elimination of a natural control factor, such as fungi or nematodes.

In the discussion that followed, diazinon [O,O-diethyl O-2-isopropyl-4-methyl-6-pyrimidinyl phosphorothioate] was stated to be effective against all stages of the Cecidomyiids. It would be most successful in control if incorporated into the compost before heating, provided that it is not inactivated by the ammonia released during that process.

HUSSEY (N.W.). **Effects of the physical Environment on the Development of the Pine Looper,** *Bupalus piniarius.*—*Rep. For. Res. 1956–57* pp. 111–128, 9 graphs, 24 refs. London, 1957.

The influence of environmental factors on the development and feeding of *Bupalus piniarius* (L.) on Scots pine [*Pinus sylvestris*] was further investigated in Britain in 1955 [*cf. R.A.E.*, A **45** 238]. Temperatures of 64–73° F. and relative humidities of 79–95 per cent. were shown in the laboratory to be the optimum conditions for oviposition; below 60° F., the

rate of oviposition declined rapidly to a threshold at 52° F. The adults were able to survive for several weeks in unsuitable weather until conditions became favourable for pairing and oviposition. The duration of the egg stage was inversely correlated with temperature [*cf.* **43** 64] and varied from 11 days at 77° F. and 100 per cent. relative humidity, with a mortality rate of 96 per cent., to 39 days at 50° F. and 80 per cent. relative humidity, with 42.5 per cent. mortality; the lowest egg mortality (2—4.5 per cent.) occurred at temperatures of 65—71° F. and 60—93 per cent. relative humidity. The mean period of development of larvae reared in glass tubes at 95 per cent. relative humidity varied from 59.2 days at 70° F. to 74.9 days at 77° F. and 159.4 days at 50° F. The third instar was the shortest in duration, except at 50° F., at which it was the longest, and the fifth instar was the longest, except again at 50° F., at which both the third and fourth instars exceeded it. Irregularities in the growth rate of fourth- and fifth-instar larvae were also observed in Germany [**43** 64], and it is concluded that small variations in temperature cause relatively large differences in growth rate.

The assimilation ratio (the amount of food eaten [*cf.* **18** 698] divided by the quantity of frass produced) fell with age and tended to be higher at 50 than at 64° F., especially in the second and third larval instars. Larvae fed several times a day for about a half to one hour at a time, and frass was excreted for about 3.5—5 hours after each period of feeding, depending on the feeding rate [*cf.* **45** 238]. Feeding was most intense in August between 9 p.m. and 2 a.m. [*cf.* **17** 597], with a subsidiary peak between 8 a.m. and 1 p.m. but the latter became the more important when midday temperatures were sufficiently high (about 80° F.). The feeding rate of young larvae was positively correlated with temperature between 50 and 77° F., but 64—70° F. appeared to be the optimum for the feeding of larvae in the fourth and fifth instars. The effects of humidity on the feeding rate were difficult to assess, but measurements of the amount of food eaten under the influence of two different evaporation rates indicated that young larvae fed more rapidly in humid conditions, whereas fourth- and fifth-instar larvae showed no preference. Field observations indicated that more feeding occurred on mild, misty nights or when dew formed at temperatures above 50° F., followed in either case by warm, sunny days. Frass deposition over about a month varied from 22.7 mg. per larva per day under such conditions to 14 mg. in cool, dull weather and to less than 10 mg. during rainy periods [*cf.* **42** 56].

There was a negative correlation between the temperature at which larvae were reared and their head-capsule width and the eventual pupal weight [*cf.* **43** 64]. All the female pupae reared in this investigation weighed less than those of the following generation, irrespective of the environmental factors experienced; rapid larval development produced pupae no heavier than those resulting from slower-growing larvae. It is concluded that the apparent limitation of recurrent outbreaks to dry areas is probably due more to the indirect effects of weather on biotic control factors than to its direct effects on *B. piniarius*.

BRIGGS (J.B.). **Some Features of the Biology of the Winter Moth (*Operophtera brumata* (L.)) on Top Fruits.** — *J. hort. Sci.* **32** no. 2 pp. 108—125, 1 pl., 6 figs., 26 refs. London, 1957.

The results are given of field and laboratory observations in south-eastern England in 1951—56 on some aspects of the bionomics of *Operophtera brumata* (L.) on fruit trees, of which it was an important pest before

the use of pre-blossom sprays of DDT became general [*cf. R.A.E.*, A **41** 305].

The first emergence of the adults was shown to be unrelated to the incidence of autumn frost, and subsequent emergence was delayed by low temperatures. Males were taken in light-traps from about mid-October to mid-January and were apparently most abundant about the beginning of December. Females were taken on adhesive bands or in traps attached to the trees from the end of October to mid-January, with peaks during the last week in November or the first in December. Most of the newly emerged females ascended the trunks immediately after nightfall, and they were followed after a few minutes by males. Mating occurred mainly on the upper parts of the trunk, but also on the lower trunk and orchard vegetation. The females continued their ascent to the upper parts of the branches after pairing and oviposited soon after; their effective life lasted about 2—3 days. Hatching usually reached a peak in the first half of April, indicating a mean incubation period of about 130—140 days; in laboratory experiments, the egg stage lasted 113—155 days, decreasing as the time of oviposition was delayed, and the results suggested that there is little variation in incubation period among the progeny of a single female, but more between those of different females. Eggs laid on 11th December and stored at field temperatures appeared to be developing in early February, and observations on apple, pear, plum and cherry showed that the hatching period varied slightly from year to year in its relation to bud development.

The larvae fed at first in the buds and blossoms, but at full-bloom and later they were found on apple on the leaves of the spur and extension growth and on developing fruitlets. Dispersal of the newly hatched larvae by wind has long been suspected, and first-instar larvae were caught on greased plates hung in apple and cherry orchards between 27th March and 23rd April; the numbers were greatest at the time of maximum hatch. No correlation was found between numbers caught and wind speed or direction. The larvae passed through all five instars by early June, and no instance of overwintering by the pupae was observed. There was considerable mortality of the immature stages, and larvae collected in May 1953 and kept in an outdoor insectary gave rise to 94 adults of *O. brumata* in the autumn of that year and 12 adults of a Tachinid parasite, *Monochaeta albicans* (Fall.), between 2nd and 29th April 1954.

DICKER (G.H.L.) & TEW (R.P.). **Some Experiments to investigate the Control of Apple Sawfly, *Hoplocampa testudinea* (Klug), by Concentrate Sprays.** — *J. hort. Sci.* **32** no. 4 pp. 254—264, 1 fig., 7 refs. London, 1957.

The following is based on the authors' summary. Small-scale field trials were carried out in south-eastern England in 1954—56 to determine whether *Hoplocampa testudinea* (Klug) could be satisfactorily controlled on apple by applying small volumes of concentrated dispersions of insecticides in strong lime-sulphur. The insecticides studied were nicotine, γ BHC, aldrin and endrin, and the last three were in the form of commercial miscible products. Sprays were applied to mature trees at the rate of 3 gal. per acre by means of a paint gun.

It was found that for each insecticide, control was inconsistent below a certain rate per acre. For γ BHC, aldrin and endrin, these agreed closely with the amounts resulting from conventional applications made by hydraulic sprays at 250 gal. per acre, and were 0.16, 1.25 and 0.31 lb. per acre, respectively. Nicotine, applied as a concentrate at a rate equivalent to

250 gal. per acre of a 0.05 per cent. solution (affording 1.25 lb. nicotine per acre), failed to control the sawfly, probably as a result of an insufficient dosage. By analogy with the results given by the other insecticides, this further indicates that occasional failures of nicotine applied by hydraulic sprays may also be due to too low a concentration in the spray.

Slight and consistently higher levels of control were obtained when γ BHC and endrin were applied with concentrated lime-sulphur, as compared with equivalent rates in water; a comparison was not made with aldrin.

TALHOUK (A.S.). **Entry and Speed of Action of Liquid Parathion in Relation to the cuticular Composition and exoskeletal Features of** *Eurygaster integriceps* **Put.** — *Z. angew. Ent.* **40** pt. 2 pp. 129–154, 17 figs., 59 refs. Hamburg, 1957. (With a Summary in German.)

Eurygaster integriceps Put. is an important pest of wheat in Syria, as elsewhere in the Middle East [*cf. R.A.E.*, A **47** 189], and parathion dusts have proved effective for its control [*cf.* **42** 327]. The author reviews the distribution and bionomics of the Pentatomid briefly and the literature on the penetration of insecticides into insects in more detail, describes the external and peripheral sensory anatomy of the adults of *E. integriceps* and records experiments on the penetration of parathion through the cuticle. Droplets of parathion (98 per cent. pure) weighing about 6 μg. were applied topically to 11 different points on the body, and the times required for 50 per cent. kill for each point of application were noted. The averages in hours, with (in brackets) the percentage mortality among the control insects in the same period, were 0.896 (0) for the tip of the proboscis, 2.36 (0) for the coxopleurite, 6.31 (0) for the metathoracic tarsus, 7.14 (0) for the first antennal segment, 7.26 (2) for the external female genitalia, 10.57 (10) for the sixth abdominal spiracle, 12.76 (4) for the sixth abdominal sternite, 16.01 (14) for the sixth abdominal tergite, 18.66 (8) for the fifth-sixth intersegmental membrane of the sternum, 22.04 (0) for the vertex of the head and 25.46 (4) for the scutellum. At all points except the tip of the proboscis and the coxopleurite, which are in direct contact with vital internal systems or organs, and the fifth-sixth intersegmental membrane and the sixth abdominal spiracle, which were not measured, there was a highly significant correlation between cuticular thickness and mean duration of survival.

DE MOL VAN OUD LOOSDRECHT (W.E.). **Die Kohlensäure-Sauerstoff-Druckmethode zur Bekämpfung der Grossen Narzissenfliege (*Lampetia equestris* F.). II. Das Töten der Made und der Zustand der Zwiebeln bei Anwendung der Kohlensäure-Sauerstoff-Druckmethode (1939–1941).** [The Control of *Merodon equestris* by Carbon Dioxide and Oxygen under Pressure. II. Larval Mortality and the State of the Bulbs when Carbon Dioxide and Oxygen are used under Pressure (1939–41).] — *Z. angew. Ent.* **36** pt. 3 pp. 334–357, 6 figs., 1 ref. Berlin, 1954. **III. Die Behandlung der Zwiebeln in der zweiten Hälfte 1941.** [Treatment of the Bulbs in the second Half of 1941.] — *Op. cit.* **38** pt. 1 pp. 49–66, 1 fig., 2 refs. 1955. **IV. Das Blühen der erst behandelten und dann forcierten Zwiebeln im Frühjahr 1942.** [The Flowering of treated and then forced Bulbs in the Spring of 1942.] — *Op. cit.* **40** pt. 2 pp. 161–174, 8 figs., 3 refs. Hamburg, 1957. (With Summaries in English.)

The author shows in the first of these parts of a series [*cf. R.A.E.*, A **43** 191]

that the period for which *Narcissus* bulbs must be treated with a 1:4 mixture of carbon dioxide and oxygen at a pressure of 12 atmospheres for the control of the larvae of *Merodon* (*Lampetia*) *equestris* (F.) can be reduced to 10 hours until about mid-September and to 15 hours until about mid-October, in the second that the oxygen in the mixture cannot be replaced by compressed air, that treatment for only 8 hours is sometimes sufficient and that the most effective gas mixture contains 30 per cent. carbon dioxide and 70 per cent. oxygen, and in the last that treated bulbs planted at the right time suffer no ill-effects from the treatment.

FRITZSCHE (R.). **Zur Biologie und Ökologie der Rapsschädlinge aus der Gattung** *Meligethes*. [On the Biology and Ecology of the Rape Pests of the Genus *Meligethes*.] — *Z. angew. Ent.* **40** pt. 2 pp. 222–280, 17 figs., 61 refs. Hamburg, 1957. (With a Summary in English.)

In view of the uncertainty as to the relative importance of the larvae and adults of *Meligethes aeneus* (F.) and of this and other species of the genus as pests of rape in Germany and the results of a preliminary survey of the distribution of these Nitidulids there in 1951 [*cf. R.A.E.*, A 42 353], a further survey was carried out in 1952. Catches were made on rape in all the vegetation regions into which Germany is divided, except Bavaria, for which data were available from the literature, and the distribution of the ten species found is shown for the whole country on a map. *M. aeneus*, *M. viridescens* (F.) and *M. coracinus* Sturm occurred throughout the country, and *M. picipes* Sturm was widespread in the northern and central districts; the other species were of local or chance occurrence only.

Observations on the bionomics of the four main species were carried out in 1952–54 in three different vegetation regions. The adults of all four overwintered principally in forests of mixed oak and hornbeam, in fairly damp, well ventilated soil rich in humus, usually at a depth of 1–2 in. On slopes, which were preferred, *M. viridescens* and *M. picipes* sought the higher positions that dried out more quickly in spring. Factors thought likely to influence the spring resumption of activity included the temperature and moisture content of the soil, and the amount of carbon dioxide in it, which depends on the activities of micro-organisms and is at its lowest in January and its maximum in July. When overwintering adults were removed from the soil and brought into the laboratory, those of *M. aeneus* and *M. coracinus* began to crawl at 8° C. [46.4° F.] and those of the other two species at 10–11° C. [50–51.8° F.], but no feeding occurred until February or early March, when the fat-body had almost disappeared. When adults were kept in soil that had an optimum humidity level of 18–20 per cent. and had been sterilised to eliminate micro-organisms, emergence from the soil began at about 8° C. for *M. aeneus* and 10–11° C. for the other three species, and became general at about 10–11° C. for *M. aeneus*, 15–20° C. [59–68° F.] for *M. viridescens* and 15° C. for the other two. When pots containing adults overwintering in soil with a moisture content of 28 per cent. were kept at 20° C., no examples of *M. viridescens* and only 20 per cent. of those of *M. picipes* had emerged at the end of ten days, whereas all those of the other two species had done so. None emerged at 35–40 per cent. soil moisture and a temperature of 25–26° C. [77–78.8° F.]. A further test, in which 4 cc. carbon dioxide was added to battery-jars about 6 in. in diameter containing overwintering adults of all species in 4 in. soil with a moisture content of 28 per cent., showed that 50 per cent. more adults had emerged after one hour at 10–15° C. than in jars to which no carbon dioxide had been added; the addition of 8 cc. caused considerable

proportions of all species to emerge at 8° C., but was ineffective at 4–6° C. [39.2–42.8° F.].

Field observations in 1953–54 on adult emergence from natural or artificially constructed winter quarters and the movement to winter rape and spring flowers largely confirmed the laboratory results. Adult flight to rape was measured by jarring the insects from the plants or by trapping them in coloured dishes of water, as used for aphids [*cf.* **41** 8, etc.], placed on the ground and at bud height. Yellow dishes were generally preferred to those of other colours. *M. aeneus* appeared in March, the date depending on the weather. The beetles fed at first on wild flowers near their overwintering sites and moved to winter rape after a few weeks, being numerous on these throughout April in 1953 but not until the end of that month in 1954. They gnawed into the flower buds and fed on the pollen [*cf.* **8** 452], damaging or destroying the ovaries in the process, and later attacked the open flowers, in which they also fed on the pollen. The feeding on the buds was responsible for most of the damage to winter rape. The other species appeared later and behaved similarly, but they did not move to winter rape until the second half of May and were then too late to feed on the buds, so that they were of only subsidiary importance. They were the most injurious on summer rape and turnip rape, however, which did not reach the flowering stage until late May or June, when most of the overwintered adults of *M. aeneus* had disappeared. *M. viridescens* was the commonest on these crops.

When adults of all four species were brought into the laboratory, the females preferred rape buds 2–3 mm. long for oviposition, piercing them with their mouth-parts and ovipositing on the pistil or stamens within. The optimum conditions for sexual maturation, oviposition and length of life of the females and for the development of the immature stages [*cf.* **8** 542] comprised a temperature of 20–27° C. [68–80.6° F.] and a relative humidity of at least 95 per cent. Under these conditions, females that fed on rape buds matured their eggs in 6–8 days, the duration of life of the females averaged 49–56, 43–45, 46–54 and 26–33 days for *M. aeneus*, *M. viridescens*, *M. coracinus* and *M. picipes*, respectively, and the numbers of eggs laid per female in rape buds averaged 206–211, 70–71, 32–34 and 24–33, respectively. Females that fed solely on spring flowers laid a maximum of only 8 eggs each. Under the same conditions, the egg stage lasted 4, 3–4, 4 and 4–5 days for the four species, respectively, and the three larval instars lasted 2–3, 7–11 and 9–11 days and the pupal stage 10–11 days for all species. The larvae fed in the buds, apparently attacking the stamens only, except at the end of the flowering period, when those of *M. picipes*, *M. viridescens* and *M. coracinus* also damaged open flowers and young pods. The damage caused was only slight. A list is given of 11 plants on which they were able to complete their development. The adults emerged from early June to mid-July, fed on the pollen and nectar of various flowers and sought their winter quarters from mid-July, probably as a result of reduced atmospheric humidity.

BUHL (C.). **Beobachtungen über das Vorkommen der echten "Hessenfliege"** *Mayetiola destructor* **(Say) in Norddeutschland.** [Observations on the Occurrence of the true Hessian Fly, *M. destructor*, in northern Germany.] — *Z. PflKrankh.* **64** pt. 5 pp. 271–286, 3 refs. Stuttgart, 1957. (With a Summary in English.)

Rye clones grown at a plant-breeding station near the Dutch border in the Ems district of north-western Germany were found in the autumn of 1955

to be infested by a species of *Mayetiola* identified by the author and Barnes as *M. destructor* (Say); the identification was confirmed by comparison with material from the United States. The clones were grown by a special process that delayed ear-formation, so that the plants remained in the "grass stage" for long periods and food was continually available for the larvae. Observations were made in 1956 on the occurrence of the Cecidomyiid on these plants and in neighbouring fields of rye and also on various cereals grown in the greenhouse or field in Schleswig-Holstein, where infestation was found to be widely distributed. Wheat, rye and barley were attacked, but not oats, tillers were preferred to main shoots, and damage was of no economic importance except in experimental plots and greenhouses where crops were grown continuously or at times particularly favourable to the development of the Cecidomyiid. In both areas, the adults generally appeared in May. Males lived for 1—3 and females for 2—4 days in the field and for rather more in the greenhouse, and the females laid an average of 178 and a maximum of 325 eggs each. The eggs were deposited singly or in groups on the upper surfaces of the lower leaves. The larvae hatched in about 5—7 days, moved down the leaves and entered the space between a ligule and the stalk. Here they moulted, established themselves just above a node, usually the lowest on the plant, and began feeding. Infested stalks bent over at this point, or were broken off by the wind, and produced little grain. Damage was most severe in greenhouses, where attack extended higher up the stalks, preventing the ears from emerging. The larvae required 24—30 days for development, after which puparia were formed. Adult emergence began towards the end of July, reached a peak at the end of August and was virtually completed by mid-September. Examination of first-generation puparia collected from wheat stubble at Kitzeberg, in Schleswig-Holstein, between 26th October and 14th December and from rye stubble in the Ems district in October showed that 27.3 and 65.3 per cent. had given rise to adults, 21.7 and 19.2 per cent. had dried up, 43.6 and 13.1 per cent. were parasitised and 7.4 and 2.4 per cent. contained overwintering larvae. The first-generation adults oviposited on cereal crops when these were available, but mainly on self-sown plants or on *Agropyrum repens*. Development of the second generation was somewhat slower than that of the first, and the last-instar larvae overwintered in the puparia. Ploughing destroyed most of them. Adults of a further generation began to emerge in a heated glasshouse on 7th January, and larvae hatched normally from eggs laid on rye. The food-plant range of the fly was confirmed by unpublished observations made at Kitzeberg in 1929 by H. Blunck, who found that infestation was confined to varieties of wheat, barley and rye, among cereal crops, and *Aegilops ovata*, among wild grasses.

Of the parasites reared from first-generation puparia collected in the two areas, *Platygaster hiemalis* Forbes [*cf. R.A.E.*, A **29** 619; **41** 53] and a species of the same genus thought by C. Ferrière to be *P. herrickii* Pack. were the most numerous and about equally important. Up to 25 examples of *P. hiemalis* developed in a single host, and pupation took place in cocoons within the host puparium. The adults emerged in spring, considerably later than those of *M. destructor*, and the females oviposited in the larvae. Parasite larvae were observed in autumn in overwintering first-generation larvae of *M. destructor*, and presumably overwintered in them, but they were also numerous in overwintering second-generation larvae in self-sown cereals, which were about twice as heavily parasitised as the first generation. The other species of *Platygaster* was found singly in the puparia, in which the adults overwintered. Three other parasites, *Pediobius metallicus* (Nees), *Eupteromalus hemipterus* (Wlk.) and *Tetrastichus carinatus* Forbes, were reared at Kitzeberg, in small numbers only.

The bionomics and food-plants of *M. destructor* as observed in north-western Germany are compared with those recorded in southern Germany for *M. secalis* Bollow, which is considered by Hennig and by Barnes to be a synonym of *M. destructor* [*cf.* **44** 194]. No important differences are apparent, and as comparison with Bollow's material merely showed a difference in coloration, which is difficult to evaluate from permanent microscope preparations, it is concluded that *M. secalis* can be at most a colour variety of *M. destructor*.

KRIEG (A.). **Über die Möglichkeit einer Bekämpfung des Kohlweisslings (*Pieris brassicae*) durch künstliche Verbreitung einer Bakteriose.** [On the Possibility of controlling *P. brassicae* by the artificial Distribution of Bacteria.] — *Z. PflKrankh.* **64** pt. 6 pp. 321–327, 4 figs., 22 refs. Stuttgart, 1957. (With a Summary in English.)

A strain of *Bacillus thuringiensis* received from E.A. Steinhaus and referred to as 12-16-54 was tested for the control of *Pieris brassicae* (L.) at Darmstadt. Spores were collected in 1955 from a culture of the bacillus on a synthetic medium, and larvae in the third, fourth and fifth instars were confined in the laboratory on cabbage leaves that had been dipped in a suspension containing 25 million spores per cc. The temperature was about 18° C. [64.4° F.] and the relative humidity 80 per cent. Half the larvae were dead after two days and all were dead after five, whereas larvae feeding on untreated leaves suffered not more than 10 per cent. mortality in six days. In a field test with the same spore material in 1956, a plot containing 22 cabbage plants infested with 10–100 third- and fourth-instar larvae per plant was sprayed at 15–18° C. [59–64.4° F.] with 2 litres of a suspension containing 125 million spores per cc., with the addition of methylcellulose as an adhesive. Counts showed that half the larvae were dead after three days and all after six. They showed typical symptoms of infection with the bacillus, and none died as a result of parasitism by *Apanteles glomeratus* (L.) [*cf. R.A.E.*, A **45** 127]. A similar control plot was sprayed with water only; mortality did not exceed 10 per cent. after six days, but 60 per cent. of the larvae were attacked by the Braconid.

NIKLAS (O.F.) & FRANZ (J.). **Begrenzungsfaktoren einer Gradation der Roten Kiefernbuschhornblattwespe (*Neodiprion sertifer* (Geoffr.)) in Südwestdeutschland 1953 bis 1956.** [Limiting Factors in an Outbreak of *N. sertifer* in south-western Germany in 1953–56.] — *Mitt. biol. Bundesanst. Berl.* pt. 89, 39 pp., 9 figs., 4 pp. refs. Berlin, 1957. (With a Summary in English.)

An outbreak of *Neodiprion sertifer* (Geoffr.) occurred in plantations of pine 8–15 years old near Darmstadt in 1952–56; the population reached its peak in 1954 and then declined, but defoliation increased until 1955. Observations were made in 1953–56 on the bionomics of the sawfly and, in particular, on the effect of natural control factors. The methods used are described. In general, the females oviposited from about mid-September to the beginning of November, laying 1–13 and an average of 6.6 eggs per needle and, in 1954–55, average totals of 65.2–67.6 eggs each. Egg mortality appeared to reach a maximum in the winter of 1953–54, when 2.2 per cent. of the eggs were parasitised by *Tetracampe diprioni* Ferrière [*cf. R.A.E.*, A **47** 74] and 13.5 per cent. were destroyed by other factors, and fell to a minimum in 1955–56, when the corresponding percentages

were 0 and 6.9. The larvae hatched in April and completed their feeding by 4th—24th June, doing so the earliest in 1954, when development was terminated by virus disease. Climatic conditions appeared to have had little influence. Larvae in the first two instars together suffered 20—55 per cent. mortality, this being highest in 1955, when the weather was cold, those in the third and fourth about 17—30 per cent. and those in the fifth 13—46 per cent. Some additional mortality may have been caused by predators, but it did not exceed 3 per cent. The only predator consistently present was *Rhynocoris annulatus* (L.), which was nevertheless uncommon. Deaths among the younger larvae were due to various causes, but most of those among fourth- and fifth-instar individuals were caused by the virus disease, and deaths from this reached a maximum in 1954. Of larvae that left the trees to pupate in the soil, only 8.7 per cent. had spun cocoons after nine weeks, the factors involved in this very high mortality being unknown.

Cocoons collected each June—October were kept in the laboratory at outside temperatures. Of those spun the same year, the percentage giving rise to adults in the same or the following year fell from 14.7 for cocoons collected in 1953 to 0.6 for those collected in 1955 and was 4.2 for those collected in 1956. Parasitism ranged from 4.6 to 14.6 per cent., and the percentages destroyed by predators ranged from 50.8 for 1953 to 88.4 for 1956. Of cocoons that had overwintered in the field, 29 and 14.2 per cent. gave rise to adults in 1953 and 1954, respectively; parasitism among these was 9.2 and 1.7 per cent., and the percentages destroyed by predators were 53.5 and 81.5. Mortality due to other factors ranged from about 1 to 20 per cent. Of the parasites emerging from the cocoons, *Aptesis basizona* (Grav.) and *Agrothereutes abbreviator* (F.) both oviposited in the cocoons, and *Aptesis* had two generations a year, the adults emerging from early March to mid-May in 1954 and 1955 and presumably ovipositing in the overwintered cocoons or in an alternative host, and again from mid-June to October. *Exenterus amictorius* (Panz.) *E. abruptorius* (Thnb.) and *Lamachus* (*Torocampus*) *eques* (Htg.) oviposited in the older larvae. *L. eques* emerged in March (but would do so later in the field), and had one generation a year. *Exenterus* spp. had two generations a year, the adults emerging from early March to early April, and ovipositing in older larvae, and again mainly from early July to early August, but also in mid-September, and presumably attacking an alternative host. *Dahlbominus fuscipennis* (Zett.) is largely restricted to cocoons above ground level [*cf.* **23** 747], and was found only in cocoons formed in cages. *A. basizona* comprised generally half or more of the cocoon parasites and *Exenterus* spp. most of the rest. Small mammals, which destroyed about as many cocoons as the other predators in 1953—54, became by far the most important in 1955, when maximum defoliation of the trees increased soil insolation and encouraged the growth of grass. Elaterids caused up to 25 per cent. mortality of cocoons, birds not more than 5 per cent. Adults of *N. sertifer* emerged throughout the year, but mainly in September. The over-all ratio of males to females was nearly 1:1 but females greatly predominated from overwintered cocoons.

DREES (H.) & HERFS (W.). **Die Polyphagie des Nelkenwicklers** *Tortrix pronubana* **Hb. im Hinblick auf seine Einbürgerungsmöglichkeit in Mitteleuropa.** [The Polyphagy of *T. pronubana* with Reference to the Possibility of its Establishment in Central Europe.] — *Pflanzenschutzberichte* **19** pt. 1—9 pp. 21—35, 7 figs., 5 refs. Vienna, 1957. (With a Summary in English.)

Infestation of carnation in the Italian Riviera by the polyphagous *Tortrix*

pronubana Hb. [*cf. R.A.E.*, A **15** 277] became widespread during and after the late war. This Tortricid has been reported on carnation in Germany on two occasions, in 1925–29 in glasshouses and beds at a nursery near Breslau [**18** 182, etc.] and in more recent years in glasshouses at Bühl, Baden, but was eradicated in each case. In view of the possibility of its becoming established in Germany [*cf.* **27** 218] or climatically similar regions as a result of the import of infested material, investigations were carried out at Cologne, mainly in the laboratory, on the suitability of various plants for its development. The results are given in detail. Development was completed on some 20 plants other than carnation, including fruit trees and bushes, and development was in many cases fairly rapid and mortality low. On a few further plants, the younger larvae were unable to survive, but the older ones developed normally.

DOSSE (G.). **Vergleichende Untersuchungen an *Brevipalpus phoenicis* Geijskes und *Br. inornatus* Banks (Acar., Phytoptipalpidae).** [Comparative Investigations on *B. phoenicis* and *B. inornatus*.] — *Pflanzenschutzberichte* **19** pt. 1–9 pp. 36–44, 9 figs., 5 refs. Vienna, 1957. (With a Summary in English.)

Brevipalpus phoenicis (Geijskes), which was described from glasshouses in Holland in 1939 [*cf. R.A.E.*, A **37** 301], was not observed in Europe again until 1951, when it was found causing serious damage to *Phoenix canariensis* in glasshouses in Vienna. Characters are given distinguishing the adults, nymphs and larvae from those of the very similar *B. inornatus* (Banks), which was present in the same glasshouses on azalea [**47** 193], and their bionomics, which are also very similar, are compared. No males of *B. phoenicis* were found, and the eggs of both species were laid on the lower surfaces of the leaves. At 24° C. [75.2° F.], the average durations, in days, of the egg, larval, protonymphal and deutonymphal stages of *B. phoenicis* and (in brackets) *B. inornatus*, both reared on ivy, were 9.9 (9.8), 5.7 (5.5), 5.9 (5.5) and 6.7 (5.5), respectively.

ZWÖLFER (H.) & KRAUS (M.). **Biocoenotic Studies on the Parasites of two Fir- and two Oak-Tortricids.** — *Entomophaga* **2** no. 2 pp. 173–196, 3 figs., 38 refs. Paris, 1957. (With a Summary in German.)

Investigations on the insect parasites of *Choristoneura murinana* (Hb.) on silver fir (*Abies alba*) near Ribeauville in the Vosges Mountains of France [*cf. R.A.E.*, A **46** 466, etc.] were continued in 1956 and broadened to include their interrelations with the parasite complexes of three other Tortricids, *Enarmonia* (*Eucosma*) *rufimitrana* (H.-S.) on silver fir, and *Archips xylosteana* (L.) and *Tortrix viridana* (L.), on oak (*Quercus petraea*). These three species were 1.5, 12 and 8 per cent. as abundant, respectively, as *C. murinana*. The degree of parasitism of *C. murinana* (8 per cent. for the larvae and 38.5 per cent. for the pupae immediately before emergence) was almost the same as in 1955 (**46** 466), although the infestation of silver fir by the Tortricid had decreased by 10 per cent. The primary parasites reared from *C. murinana* comprised the Ichneumonids, *Pimpla turionellae* (L.), *Apechthis resinator* (Thnb.), *Ephialtes inquisitor* (Scop.), *Itoplectis maculator* (F.), *Phytodietus* sp. (near *P. segmentator* Grav.), *Phaeogenes maculicornis* (Steph.) (*scutellaris* Wesm.), *Cephaloglypta murinanae* (Bauer), *Glypta* sp. (near *G. cicatricosa* Ratz.), *Chorinaeus longicornis* Thoms., *Triclistus globulipes* (Desv.), *Tranosema arenicola* Thoms., *Blaptocampus*

nigricornis (Wesm.) and *Agrypon varitarsum* (Wesm.), a Braconid of the genus *Apanteles* [*murinanae* Čapek & Zwölfer (47 42)], two Chalcidoids, *Monodontomerus aereus* Wlk. and *Amblymerus subfumatus* (Ratz.), and four Tachinids of no significance. *P. maculicornis* and *I. maculator* were the only species of importance, parasitising 22.8 and 11.5 per cent. of *Choristoneura murinana*, respectively. Five Ichneumonids and two Chalcidoids occurred as hyperparasites. The interrelations of primary and secondary parasites with larval and pupal populations of *C. murinana* on mature firs are shown in a diagram, and the importance is stressed of parasites playing both primary and secondary rôles; *A. subfumatus* killed 3.8 per cent. of the most important pupal parasites, *Itoplectis* and *Phaeogenes*, 4.2 per cent. of *Apanteles*, and only 0.9 per cent. of *Choristoneura*, and *I. maculator* destroyed a quarter of the Tachinid pupae, all the *Tranosema* pupae, and 28 per cent. of *Cephaloglypta*. The value of *I. maculator* in the control of *Choristoneura murinana* is diminished by its dependence on alternate hosts, so that its population levels are not related to those of *C. murinana*, and its parasitism of *Cephaloglypta* greatly reduces the efficiency of this Ichneumonid, which should theoretically reach peak populations at the same time as *Choristoneura*.

Larvae of *Enarmonia rufimitrana* were parasitised by two Ichneumonids, *Angitia* (*Horogenes*) *exareolata* (Ratz.) and *Lissonota* sp., and by *Apanteles murinanae*, and the pupae by *Phaeogenes osculator* (Thnb.) (*nanus* Wesm.). Larvae of *Archips xylosteana* were parasitised by *Phytodietus* sp. (near *P. segmentator*), *T. arenicola*, *Lissonota* sp., *B. nigricornis*, *Meteorus pallipes* (Wesm.) and unidentified species of *Apanteles*, *Microgaster* and *Clinocentrus*, and the pupae by the Ichneumonids, *Apechthis rufata* (Gmel.) and *Exochus decoratus* Hlmgr. Larvae of *Tortrix viridana* were parasitised by *Phytodietus* sp. (near *P. segmentator*), *Ephialtes inquisitor*, *G. cicatricosa*, *Tranosema arenicola*, *Meteorus pallipes* and *Clinocentrus* sp., and the pupae by *A. rufata*, *A. resinator*, *Phaeogenes invisor* (Thnb.) (*stimulator* (Grav.)) and *I. maculator*.

It is pointed out that more than half the parasite species were reared simultaneously from two or three of the Tortricids, but that each host, and especially those on fir, was attacked by a typical parasite complex; their interrelations are shown qualitatively and to some extent quantitatively in a diagram including information derived from the earlier work [46 466]. Parasites shown to be important exhibited a marked preference for the Tortricid concerned, although several of them are known to be polyphagous. The attraction of *Choristoneura murinana* for *A. rufata* was investigated by transferring unparasitised pupae to artificially-formed leaf-rolls on oak resembling those made by the oak Tortricids. From 153 pupae, 13 adults of *A. rufata* were subsequently reared, as compared with none from more than 5,000 pupae collected from the same stand on firs, from which it was concluded that the attraction is primarily to the food-plant and only secondarily to the host [*cf.* 47 265, etc.]. The behaviour of *A. rufata* in the Vosges was exceptional, however, since it was reared from *C. murinana* on fir in the Black Forest and Slovakia, and such variations are probably of a purely phenotypic nature. The preference of *I. maculator* for *C. murinana*, as compared with its neglect of *Archips xylosteana* and virtual neglect of *T. viridana*, appears to be an example of selection by a gradually developed preference for the most abundant host species.

In areas in which *C. murinana* and fir do not occur, *I. maculator* has been recorded as the dominant parasite of *T. viridana*, and the observations on both it and *A. rufata* emphasize the remarkable plasticity that exists in the responses of parasitic insects.

FRANZ (J.). **Beobachtungen über die natürliche Sterblichkeit des Kartoffelkäfers** *Leptinotarsa decemlineata* **(Say) in Kanada. (Vorläufige Mitteilung.)** [Observations on the natural Mortality of *L. decemlineata* in Canada. (Preliminary Communication.)]—*Entomophaga* **2** no. 2 pp. 197–212, 4 figs., 9 graphs, 8 refs. Paris, 1957. (With a Summary in English.)

Investigations were carried out in a field of potatoes near Belleville, Ontario, in June–August 1956 on the effectiveness of parasites and predators in reducing populations of *Leptinotarsa decemlineata* (Say) in a region near the northern limit of its distribution, with a view to the introduction of suitable species into western Germany [*cf. R.A.E.*, A **20** 561; **26** 594, etc.]. Some of the plants were left unprotected, some were surrounded by a metal strip extending 2 in. above the soil and coated with adhesive, some were enclosed in a cage having meshes about 1 in. wide, and some were enclosed together or individually in cages with meshes only 0.07 in. wide. Counts of eggs and of larvae of *L. decemlineata* ready to enter the soil for pupation were made at intervals, and comparison of the results showed the mortality that had been caused during development by factors other than parasites, which kill the larvae only after they have entered the soil. Mortality was about 80 per cent. on all plants except those kept together in the narrow-mesh cage, on which it fell to 54 per cent. It was thus apparent that birds and crawling insect predators played no part in control. Flying insects, of which the Pentatomid, *Perilloides* (*Perillus*) *bioculatus* (F.), was apparently the most important [*cf.* **12** 59; **20** 561], were mainly responsible. Destruction of eggs by larvae and adults of *L. decemlineata* may also have contributed to the mortality, but the effects of weather were probably slight. Parasitism was investigated by collecting and rearing fourth-instar larvae. The Tachinid, *Doryphorophaga doryphorae* (Ril.), the most important, was reared from less than 10 per cent. of them during July, but from 50 per cent. by mid-August [*cf.* **25** 366]. Its developmental cycle was out of phase with that of its host, the numbers of *L. decemlineata* declining in late July, whereas maximum numbers of *D. doryphorae* were not reached until late August. The parasite would doubtless be more effective where *L. decemlineata* produces a second generation in the year. It is concluded that further investigation is necessary before introductions are made into Germany.

KHAN (M. A.). *Sphaerularia bombi* **Duf. (Nematoda: Allantonematidae) infesting Bumblebees and** *Sphaerularia hastata* **sp. nov. infesting Bark Beetles in Canada.** — *Canad. J. Zool.* **35** no. 4 pp. 519–523, 1 pl., 7 figs., 2 refs. Ottawa. 1957.

Nematodes of the genus *Sphaerularia* are reported in Canada for the first time in this paper, in which *S. bombi* is recorded from the abdominal cavity of queens of *Bombus terricola* Kby. and *B. ternarius* Say in Saskatchewan and *S. hastata*, sp. n., is described in all stages from *Dendroctonus pseudotsuga* Hopk., *D. ponderosae* Hopk. (*monticolae* Hopk.), and the cocoons of the Hymenopterous parasite, *Coeloides dendroctoni* Cushm., in British Columbia.

HARVEY (G.T.). **The Occurrence and Nature of Diapause-free Development in the Spruce Budworm,** *Choristoneura fumiferana* **(Clem.) (Lepidoptera: Tortricidae).** — *Canad. J. Zool.* **35** no. 4 pp. 549–572, 1 pl., 5 figs., 27 refs. Ottawa, 1957.

The following is largely the author's summary. Populations of *Choristo-*

neura fumiferana (Clem.) in eastern Canada are effectively univoltine. After hatching, the larva follows a complex behaviour pattern that leads to the building of a hibernaculum in which it moults and spends the winter months without feeding. This pattern seems to be independent of environmental conditions, except as they affect the rate at which the component events occur, and, in the absence of any evidence to the contrary, must be considered as inherent.

Laboratory studies, in which rearing was carried out by a method already noticed, with freshly thawed buds of balsam fir [*Abies balsamea*] as the food [*cf. R.A.E.*, A **44** 225], showed that in 62 per cent. of the families produced by mating field-collected individuals, at least one larva could develop without diapause if subjected to long photoperiods (at 71° F.); on the average, 3—4 per cent. of the second-instar larvae in such progenies could forego diapause. Selection over six generations yielded a strain that, if subjected to continuous light in the laboratory, was virtually free from diapause. This stock was reared for a further six generations and still retained this photoperiod dependence. Behaviour was usually normal during hibernaculum construction and moulting, but then the larvae vacated their shelters, fed readily, and developed without any delay. No associated differences were found between non-diapause and normal insects. The ability to develop without diapause is apparently determined by multiple genes; it is not sex-linked, but may be to some extent sex-controlled.

Diapause-free development in this strain resulted only when first-instar larvae were exposed to a photoperiod of at least 15 hours, shorter times resulting in almost universal diapause and longer times giving a progressively greater proportion of non-diapause insects, approaching 100 per cent. in continuous light. This response was reduced by lower temperatures. Potential non-diapause insects deprived of a light treatment behaved as normal insects; under appropriate conditions of light, their progeny in turn developed without diapause.

Similar non-diapause development was observed in *C. pinus* Freeman.

GHENT (A.W.), FRASER (D.A.) & THOMAS (J.B.). **Studies of Regeneration in Forest Stands devastated by the Spruce Budworm. I. Evidence of Trends in Forest Succession during the first Decade following Budworm Devastation.** — *For. Sci.* **3** no. 2 pp. 184—208, 4 figs., 21 refs. Washington, D. C., 1957.

GHENT (A.W.). **II. Age, Height Growth, and related Studies of Balsam Fir Seedlings.** — *Op. cit.* **4** no. 2 pp. 135—146, 6 figs., 9 refs. 1958.

The following paragraphs are based almost entirely on the authors' summaries. For many years, differences of opinion have existed as to the rôle of *Choristoneura fumiferana* (Clem.) in forest succession. Whereas in recent years interest has centred on the theory that the proportion of balsam fir (*Abies balsamea*) in mixed stands of this species with white spruce (*Picea glauca*) and, less commonly, black spruce (*P. mariana*) tends to increase after outbreaks, an earlier one suggested that the marked preference shown by *C. fumiferana* for balsam fir might tend to increase the proportion of spruce in succeeding stands. Data on forest succession and related problems obtained during studies in stands devastated by *C. fumiferana* in north-western Quebec and north-central and north-western Ontario are presented. They confirm the view of K. B. Turner that mortality of balsam fir following such devastation is correlated with the percentage of the total basal area occupied by this tree. Evidence was obtained of a curvilinear progression in the frequency of occurrence of successively less

abundant shrub species among those that have come to dominate many of the devastated study areas. Balsam-fir and spruce seedlings were found to have similar frequency distributions by height classes, both immediately after devastation and after five years of unsuppressed growth following removal of the overstory. This observation indicates that there is no appreciable difference between balsam fir and spruce in either their shade tolerance or their ability to profit from release from suppression. A decrease of 20—65 per cent. in numbers of balsam-fir seedlings was observed between regeneration tallies conducted in 1950 and 1955. Correlation analysis indicated that about 72 per cent. of this decrease could be attributed to coverage by wind-broken trees killed by *C. fumiferana;* a further 16 per cent. appeared attributable to competition from shrubs, but is probably not totally independent of that already attributed to coverage by broken trees. Trends in forest succession, as indicated by comparisons of the ratios of balsam fir to spruce in the original stands and in the seedling populations, proved to be strongly dependent upon the region in which the data were gathered. Data from north-western Quebec indicated a general increase in the proportion of spruce, while those from north-central Ontario showed a consistent increase in proportion of fir. Data from north-western Ontario suggested a slight increase in fir, but the evidence was not conclusive. Comparison of the fir-spruce ratios measured by the 1950 and 1955 seedling tallies indicated no general trend towards an increase in either spruce or fir during this period. Changes that did occur were again regionally dependent, but on only one of the 26 study plots was the change sufficiently great to reverse the trend already indicated by comparison of the 1950 tally with the original stand. The available evidence suggests that established balsam-fir and spruce seedlings are more remarkable for their ecological equivalence than for any differences in ability to survive under competition that can be detected in the data presented. There is some evidence to suggest that differential establishment of new seedlings, particularly spruce seedlings, may bring about minor changes in the ratio between spruce and balsam fir after an outbreak of *C. fumiferana.* It is suggested that the apparent regional dependence of trends in forest succession following devastation has been at least partly responsible for the divergent theories on the rôle of the Tortricid.

Balsam-fir seedlings present in a forest area (Black Sturgeon Lake) in Ontario north of Lake Superior following a recent outbreak of *C. fumiferana* represented an accumulation that had been increasing for 20—30 years before the outbreak. Studies of the flowering history of remnant survivors of the balsam-fir overstory substantiated the conclusion based on seedling-age studies that an early effect of defoliation was the cessation of female-flower production. Before the outbreak, shade-tolerant but severely suppressed balsam-fir seedlings had grown at an average rate of just over 1 inch per year. Damage to seedling leaders by the feeding of late-instar larvae nullified any possible influence that concurrent overstory defoliation might have had upon seedling release. Height growth responded immediately, however, when the period of peak insect populations had passed and heavy overstory mortality began. The number of terminal-lateral buds increased leader length, and appears to be an equally valid criterion of seedling vigour. Satisfactory histories of recent outbreaks of *C. fumiferana* can be obtained from the evidence of damage to the main axis of seedlings, caused by the feeding of late-instar larvae that drop from the overstory; the beginning, end, and peak years of an outbreak are accurately portrayed. Measurements of the seed productivity of balsam fir in a mixed stand indicated that nearly 8,000,000 seeds per acre had been produced over a 37-year flowering period. On the average, only one seedling became established

for every 1,500 seeds produced. During the first half of this flowering period, however, one seedling became established for every 600 seeds produced, suggesting that the availability of seedling niches quickly became a limiting factor in establishment.

LEACH (R.). **Dieldrin effective controlling Banana Borer.** — *Farmer* 62 pp. 204–211, 3 figs. Kingston, Jamaica, 1958.

In this account of work on the control of *Cosmopolites sordidus* (Germ.) on banana in Jamaica, the author reports that the introduction of the predacious beetle, *Plaesius javanus* Erichson, into four infested plantations apparently caused no diminution of borer numbers [*cf. R.A.E.*, A **29** 445] but that dieldrin gave very effective control [*cf.* **46** 367; **47** 82]. A dieldrin spray applied to the bases of the plants at 1.5 lb. toxicant per acre proved much superior to γ BHC or a proprietary insecticide applied to the cut surface or to traps (pieces of pseudostem), both of which treatments were ineffective, but it gave complete protection for only a few months, whereas dust applications of 50 per cent. wettable dieldrin powder in gypsum (4:96) to the soil round the base of each plant mat after removal of the trash or in artificial fertiliser round the roots in February 1957, at the rate of 2 lb. dieldrin per acre, reduced the numbers of weevils caught in traps exposed at intervals from June 1957 to January 1958 to 0–4, as compared with 8–40 in untreated areas. It is considered likely that treatment at half this rate would be effective, though for a shorter time. The dust should be applied when the soil is wet with dew or rain, so that it is not blown away.

A new type of trap is described, in which a pseudostem from which the crop has recently been harvested is cut across at a height of 6 in. and again at ground level; the six-inch portion is replaced in its original position, and the weevils congregate freely between the cut surfaces at ground level. More than three times as many were taken in these as in traps of the usual type, consisting of pieces of pseudostem, cut in half lengthwise and laid on the ground.

PROCTOR (J.H.). **A Note on Cotton Insects in British Guiana.** — *Emp. Cott. Gr. Rev.* **35** no. 2 pp. 107–110, 5 refs. London, 1958.

Cotton, which was formerly cultivated on a large scale in British Guiana, has not been grown commercially there for many years, despite several attempts to revive the industry, and the insects likely to be injurious to commercial crops, with the possibilities of controlling them, were investigated in 1955. Three species of *Dysdercus* have been recorded on cotton in the Colony. The most important is one that is known locally as *D. rufi-collis* (L.), though it may represent the continental form of *D. howardi* Ballou, and the others are *D. howardi* and *D. fuscofasciatus* Blöte; *D. maurus* Dist. and *D. mimus* (Say), which infest cotton in Trinidad [*cf. R.A.E.*, A **21** 356], are known from *Malachra capitata* in British Guiana, but do not attack cotton there. Attack was heavier and more prolonged on the autumn crop, which is sown in May and picked in September–October, than on the spring crop, which is sown in November and picked in March–April, possibly because the autumn crop is picked during the longer of the two dry seasons. Rainfall, or possibly the light intensity and changes in temperature and humidity associated with it, appeared to reduce the rate of increase. Only very small plots escaped infestation. In view of the abundance of wild food-plants, their elimination [*cf.* **28** 226] appears impracticable and

the enforcement of a close season of little value, but the use of early-maturing varieties of cotton with high flowering rates and of cultural measures to advance the cropping period would be advantageous. As chemical control would be necessary, at least during the early stages, measures suitable for use by peasant farmers were investigated. Four applications of a dust of 0.65 per cent. γ BHC at 75 lb. per acre made at ten-day intervals under favourable conditions of wind and dew gave good control of a heavy infestation that was reinforced by immigration throughout the critical growth stages of the crop, and a low-volume spray prepared from an emulsion concentrate containing 20 per cent. dieldrin diluted at ½ pint in 2 gal. water and applied at 3 gal. per acre gave good control for a month on perennial cottons of diverse habit. Advantages of the spray are that it is more economical and persistant in wet weather than the dust and, since it would have to be applied by a central organisation, responsibility for the number and timing of the applications would be removed from the farmer.

A species of *Empoasca* closely related to *E. cothurnula* Young injured the leaves and was the most important pest prior to flowering. Infestation was heaviest on large plots, on plots with abundant weeds and on poorly grown cotton; African Upland varieties were resistant. DDT dusts gave unsatisfactory control, but an emulsion spray of technical DDT at 1 lb. in 75 gal. per acre was effective provided that the lower surfaces of the leaves were thoroughly wetted, which made application slow and laborious. A low-volume emulsion spray of technical dieldrin at 0.58 lb. in 19 gal. per acre greatly reduced the population for a month, but a higher rate seemed necessary for adequate coverage at a later stage of growth.

Of the other insects observed on cotton, *Nezara viridula* (L.) and the Coreid, *Hypselonotus fulvus* (Deg.), were often present, though never very numerous. *H. fulvus* appeared to be controlled by the BHC dusts and dieldrin sprays applied against *Dysdercus*, but these insecticides destroyed Coccinellids and so favoured infestation by *Aphis gossypii* Glov., attack by which was heaviest on poorly grown cotton. *Alabama argillacea* (Hb.) was invariably present, but scarce, on both spring and autumn crops. *Agrotis repleta* Wlk. and *Scapteriscus didactylus* (Latr.) destroyed a portion of the young seedlings, and *Saissetia nigra* (Nietn.) and *Pinnaspis strachani* (Cooley) (*minor*, auct.), occurred mainly on the thick stems of perennial cottons and at the base of the old stems of annual cotton that had been ratooned. Species of *Tetranychus* infested cotton during the period of later growth in the dry season, causing leaf-fall which, however, is probably unimportant as some natural shedding occurs at this time; upland varieties, especially American Uplands, appeared to be the most susceptible to attack.

YOUNG jr. (D. A.). **A new Genus of economic Leafhoppers and Notes on the Genus *Atanus* Oman (Homoptera Cicadellidae).** — *Rev. chil. Ent.* 5 pp. 13–17, 13 figs., 6 refs. Santiago, Chile, 1957. (With a Summary in Spanish.)

Paratanus, gen. n., is erected with *Atanus exitiosus* Beamer, the vector of the virus of yellow wilt of beet in Argentina [*cf. R.A.E.*, A 35 426; 43 385], as the type, and two new species are described in it, *P. yusti*, on potato, which is seriously injured, and lucerne, and *P. sativae*, on lucerne, both in Ecuador. A key to the three species is included.

ETCHEVERRY (M.). *Laphygma frugiperda* (**Abbot & Smith**) **en Chile (Lepidoptera Noctuidae).** [*L. frugiperda* in Chile.]—*Rev. chil. Ent.* 5 pp. 183–192, 14 figs., 23 refs. Santiago, Chile, 1957. (With a Summary in English.)

Laphygma frugiperda (J. E. Smith), all stages of which are described, was found to be present in Chile for the first time in 1954. It is an important pest of lucerne and maize in the small valleys round Arica, but has not been reported from the south. In laboratory observations, the egg, larval and pupal stages lasted 3–4, 12–24 and 8–15 days, respectively, at 22° C. [71.6° F.] and 7–9, 30–45 and 18–22 days at 15° C. [59° F.]. The preoviposition period lasted 3 and 7 days at the two temperatures, respectively, and the adults survived for 10–15 days. The parasites reared from it in the laboratory comprised four Tachinids, *Archytas incasana* Tns., *A. incertus* (Macq.) [*cf. R.A.E.*, A **45** 89], *Peleteria robusta* (Wied.) and *Winthemia* sp.

OLALQUIAGA FAURÉ (G.) & CONTESSE PINTO (J.). **Pests of Grapevine in Chile.**—*FAO Plant Prot. Bull.* **7** no. 6 pp. 73–77, 3 refs. Rome, 1959.

The only mite of importance on grape vines in Chile is *Brevipalpus chilensis* Baker, which occurs throughout the central area and also infests other plants. On vines, some of the population overwinters in the buds, this portion being probably responsible for the main damage, while the remainder does so on the canes or occasionally under the bark of the stems. The mites attack the buds in spring, inhibiting normal development and weakening the plant, and later infest the leaves, which curl, turn red, are reduced in size, and fall prematurely. At the end of summer, they congregate on the basal parts of the lower surfaces of the leaves, preparatory to moving to their overwintering sites. The injury is especially noticeable in winter, as the runners show shorter internodes and their basal parts become necrotic and devoid of buds, though the terminal buds appear unaffected. Sulphur dusts or sprays, as applied for fungus control, proved ineffective against the mite, but several modern acaricides have given promising results. Weed control in and near vineyards deprives the mites of alternative food-plants.

Of the insects, the most important is *Pantomorus* (*Naupactus*) *xanthographus* (Germ.), which is common in the central zone. The adults of this weevil feed on the shoots and leaves, and also attack other plants, and the larvae damage the roots, sometimes killing the vine. Several insecticides are effective against the adults, a spray of dieldrin and parathion being the best, and DHC applied to the soil at 0.765 lb. γ isomer per acre killed 64 per cent. of the larvae.

Margarodes vitium Giard, which occurs in several countries of South America, is widely distributed in Chile. This Coccid develops in the soil [*cf. R.A.E.*, A **11** 320], and vines of which the roots are infested are dwarfed and die in 3–4 years. The females are apparently parthenogenetic, no males having been found, and they oviposit in the soil. The eggs hatch in 25–70 days, and the young Coccids attach themselves to the roots. Later, cysts are formed, from which the adult females emerge. Cysts have been observed on various plants, and they persist in the soil and provide a means of reinfestation if a vineyard is replanted. Cysts are less common in damp soils, and deep irrigation affords some temporary control. Insecticides are effective if applied in the second half of November and the first

part of December, when the females emerge from the cysts and oviposit, and in mid-January, when the eggs hatch. Aldrin and γ BHC at 0.9 lb. per acre have so far given the best results.

Eulecanium (*Lecanium*) *persicae* (F.) occurs from Aconcagua to Concepción and is a permanent pest in some areas. On vines, the growing shoots are preferred, but the leaves are also attacked. The second-stage nymphs overwinter on the stems and canes, move to the leaves in spring and reach the adult stage in September or October. Some control is afforded by natural enemies, including *Aphycus* (*Metaphycus*) *helvolus* Comp. and *A.* (*M.*) *flavus* How., but insufficient to obviate the use of insecticides. In severely infested areas, sprays of 3.5–4 per cent. oil emulsion are applied during winter and DDT dusts during the hatching period in spring.

Other insect pests recorded are the Bostrychids, *Micrapate scabrata* (Erichs.) and *Dexicrates robustus* (Blanch.), which bore in the canes, *Dictyneis pulvinosa* (Blanch.), a Eumolpid that feeds on the leaves, shoots and maturing fruit clusters, *Athlia rustica* Erichs. and *Strangaliodes mutuarius* Kuschel, which sometimes attack the leaves, *Eulia* sp. and thrips.

BROWNE (L.B.). **The Effect of Light on the Mating Behaviour of the Queensland Fruit Fly** *Strumeta tryoni* **(Frogg.).** — *Aust. J. Zool.* **5** no. 2 pp. 145–158, 8 graphs, 8 refs. Melbourne, 1957. **An Investigation of the low Frequency of Mating of the Queensland Fruit Fly** *Strumeta tryoni* **(Frogg.).** — *T. c.* pp. 159–163, 21 refs.

The following is virtually the author's summary of the first of these two papers on mating behaviour in *Dacus* (*Strumeta*) *tryoni* (Frogg.) [*cf. R.A.E.*, A **46** 358]. The effects of light during both the dusk and day periods on mating were studied. In nature, the flies mate only at dusk. The effects of several components of dusk illumination were examined. The area of the source of artificial dusk and the distance between it and the flies are not important so long as the angle subtended by the source exceeds 25°, below which sexual activity is reduced. The illuminance in the cages and not the luminance per unit area (brightness) of the source determines the amount of sexual activity. The higher the illuminance during the day period, the higher is the optimal illuminance at dusk. The rate of change from day to dusk appears to be unimportant. Light during the day periods influenced the age at which both females and males became sexually active. For females, only the effect of daily period was studied. At 24 lumens per sq. ft., those receiving light for two hours a day became sexually active later in life than those receiving light for 7½ hours a day. The age at which females become active is probably controlled by the state of the ovaries, the rate of development of which is influenced by light. Males become active later in life when kept under 120 lm. per sq. ft. for 7½ hours a day than when kept under either 60 or 240 lm. per sq. ft. for the same daily period. Those receiving 240 lm. per sq. ft. for two hours a day become active later in life than those receiving this illuminance for either 4 or 7½ hours a day. Since light does not influence the development of the testes, it is probable that it directly affects the mating behaviour of the males. Light also influences the time at which the males begin and end sexual activity each day and the period for which they remain active. Those under 120 lm. per sq. ft. begin and end activity later than those under either 60 or 240 lm. per sq. ft. and remain active for a shorter period. The greater the daily period of illumination, the earlier do they begin and end activity. At 240 lm. per sq. ft., those illuminated for 7½ hours a day remain active longer than those illuminated for 4 or 2 hours a day.

The following is virtually the suthor's summary of the second paper. Unmated females of *D. tryoni* are attracted by the mating call (stridulation) of the male and accept attempts at pairing. Females that have recently mated are attracted by the calling but repel attempts at pairing. Females that mated seven days previously are not attracted to the calling and repel any attempts. One mating is sufficient to fertilise the eggs laid at least during the first seven weeks of adult life.

MADGE (P.E.). **The Ecology of *Oncopera fasciculata* (Walker) (Lepidoptera: Hepialidae) in South Australia. IV. Fluctuations in Numbers during 1948–1955 and an Analysis of their Causes.** — *Aust. J. Zool.* 5 no. 2 pp. 196–215, 1 pl., 8 maps, 2 graphs, 6 refs. Melbourne, 1957.

The following is based largely on the author's summary of this fourth part of a series dealing with ecological investigations on *Oncopera fasciculata* (Wlk.) in the south-east of South Australia [*cf. R.A.E.*, A **46** 377]. The development of the pastoral industry in this area has, in consequence of the shelter provided in late spring by introduced clovers and grasses in improved pastures, resulted over the past 30 years in an increase in numbers of *O. fasciculata*, even during unfavourable periods between outbreaks. Although the outbreak of 1948–50 [*cf.* **44** 332] was the greatest recorded, not all the suitable pasture sites were infested and not all the available plant food was eaten, except in restricted areas. Predators have little influence on numbers, except when wet weather forces larvae, prepupae and pupae from their subterranean burrows, and no parasites were found [*cf.* **46** 378]. The numbers reached therefore depended mainly on the weather.

Weather records during 1930–55 suggest that an increase in numbers in any one generation may be expected when there are fewer than about 45 days without rain during the late egg and early larval stages (October–December). Extensive damage to pastures may be expected when there is a series of such years; this has happened only once (in 1947–49) during the past 95 years and was followed by the outbreak of 1948–50. The numbers of *O. fasciculata* on poorly drained soils are likely to increase whenever a dry, late winter (with fewer than 2–3 days of waterlogging during July–September) is followed by a wet, late spring. Changes in the distribution and abundance of *O. fasciculata* during 1948–55 described and shown on maps, and a probable explanation, chiefly in terms of weather conditions, is put forward.

Suggested measures for producing conditions less favourable to the Hepialid comprise the elimination of permanent improved pastures by the use of crop rotations and the removal of tall herbage during the flight season and the egg and early larval stages (September–December) by grazing or mowing.

FERNANDO (H.E.). **The Biology and Control of *Leptoglossus membranaceus*, Fabricius (Fam. Coreidae Ord. Hemiptera).** — *Trop. Agriculturist* **113** no. 2 pp. 107–118, 3 figs., 15 refs. Peradeniya, 1957.

The economic importance of species of *Leptoglossus* is briefly reviewed from the literature. Only *L. membranaceus* (F.) occurs in Ceylon, where it occasionally causes extensive damage to cucurbits and *Citrus*, outbreaks having occurred in 1912, in 1936 [*cf. R.A.E.*, A **25** 299] and in March–May 1957; the last two of these followed periods of severe drought. Breeding

occurs on cucurbits, and eggs and nymphs have not been observed on *Citrus*. The eggs are laid in rows on the tendrils, stems and leaves of the cucurbits, and hatch in 8—10 days. Bitter gourd (*Momordica charantia*) is preferred, but luffa (*Luffa acutangula*) and, to a less extent, snake gourd (*Trichosanthes anguina*) are also infested. The Coreid feeds on the fruits of these, but moves to the less exposed leaves or stems during the hours of strong sunlight. Attacked leaves wither and die, stems turn yellowish-brown, and the fruits become orange-red, shrivel and tend to split open; the nymphs feed mainly on the leaves and stems, but are attracted to the exposed dried seeds. On *Citrus*, feeding occurs predominantly on the fruits, which collapse internally, become discoloured, and fall prematurely. The ratio of males to females at the end of the outbreak in 1957 was 6:1.

Methods of control on cucurbits were investigated in 1957. The use of sprays was slow and hazardous, as good coverage was obtained only by walking under the vines, which also disturbed the insects. It also left excessive residues, the crops being picked and marketed weekly. Dusts were more easily applied, but only 1.3 and 3 per cent. γ BHC, at 20 lb. per acre, gave more than 95 per cent. kill of both adults and nymphs in 24 hours. All the nymphs, but only 31 per cent. of the adults, were killed by 1.5 per cent. endrin, and 10 per cent. DDT, 1 per cent. dieldrin and 2.5 per cent. aldrin were ineffective, as also was 0.5 per cent. γ BHC. Even with the effective γ BHC dusts, reinfestation from eggs laid before treatment and from migrating adults occurred within 8—10 days, and treatment had to be repeated in some areas three times before control was obtained.

FERNANDO (H.E.), ELIKEWELA (Y.) & MANICKAVASAGAR (P.). **Resistance to Benzene Hexachloride of the Rice Bug *Leptocorisa varicornis*, F. (Fam. Coreidae Ord. Hemiptera) and its insecticidal Control.** — *Trop. Agriculturist* **113** (1957) no. 3 pp. 229—240, 1 graph, 4 refs. Peradeniya, 1958.

Leptocorisa varicornis (F.), which migrates from wild grasses to rice in flower and destroys the freshly set grains, is the most important insect pest of this crop in Ceylon. Large populations develop rapidly, especially in areas where the flowering period is prolonged, and whole crops are soon completely destroyed. The use of dusts containing 0.35 per cent. γ BHC has been recommended since 1947, but these have given inadequate control in recent years, and the causes were investigated in 1954—56. In laboratory tests, adults collected from areas in which BHC had been applied every season for at least eight years, applied for a few years only, or not applied at all were treated topically with γ BHC in acetone. The results showed that strains resistant to γ BHC had developed, the LD50's varying from 0.0209 μg. per adult for bugs from two untreated districts to 0.139 μg. for those from a continuously treated area surrounded by high forest. In similar tests, endrin, dieldrin, isodrin, malathion and diazinon [O,O-diethyl O-2-isopropyl-4-methyl-6-pyrimidinyl phosphorothioate] were all less effective than γ BHC, their LD50's increasing in the order given. In field trials, 1.5 per cent. endrin or 0.65 or 1.3 per cent. γ BHC as dusts gave complete kill in an area in which medium resistance had developed, and 89.7, 97.1 and 97.8 per cent. kill, respectively, in the one in which resistance had increased six-fold, but complete mortality of the latter strain was given by sprays prepared by diluting emulsion concentrates containing 25 per cent. DDT or 20 per cent. dieldrin, endrin or γ BHC at 1 fl. oz. per gal. and one containing 60 per cent. diazinon at 2 cc. per gal., though these

were sometimes less effective against the other strain, which was protected by heavy plant growth. The toxicity of the 0.65 per cent. *y* BHC dust was reduced by the admixture of an equal amount of 1 per cent. diazinon. Dusting with 1.3 per cent. *y* BHC at a rate of 20 lb. per acre is recommended, and the poor results obtained by growers are attributed largely to faulty application.

KHANNA (K.L.), NIGAM (L.N.) & PURI (V.D.). *Chilo tumidicostalis* **Hampson — a serious Stem Borer Pest of Sugarcane in Bihar.** — *Proc. Indian Acad. Sci.* (B) **46** no. 2 pp. 75–95, 7 pls. 10 refs. Bangalore, 1957.

The following is based largely on the authors' summary. *Chilo tumidicostalis* (Hmps.) is a serious pest of sugar-cane in parts of Bihar, the larvae boring in the stalks. Surveys of its distribution showed that infestation was commoner on heavy than on light soils and under water-logged and flooded conditions; ratoons were more severely affected than the plant crop. Differences were observed in the susceptibility of sugar-cane varieties, stalks with solid cores being generally less affected than those with cavities and much pith. In investigations, the egg and larval stages lasted 8–11 and 61–121 days, respectively, the larvae overwintering, and the pupal stage lasted 8–12 days in September–October and 18–26 days in January–February. There were two and occasionally three generations a year, and the second, which is present in August–September, was the most injurious. The larvae prefer the upper parts of the stalks, and large numbers frequently congregate in a few internodes. The resulting loss in cane tonnage varied from 8.2 to 12.6 per cent. and the loss in sucrose in the juice from 10.73 to 48.55 per cent. Many of the larvae were parasitised by *Apanteles flavipes* (Cam.), notes on the bionomics of which are given; its life-cycle was completed in 25–30 days in November–December.

THAKUR (C.), PRASAD (A.R.) & SINGH (R.P.). **Use of Aldrin and Dieldrin against Termites and their Effects on Soil Fertility.** — *Indian J. Ent.* **19** (1957) pt. 3 pp. 155–163, 6 refs. New Delhi, 1958.

Tests to find the most effective doses and formulations of aldrin and dieldrin for the control of *Microtermes obesi* Hlmgr., *Odontotermes assmuthi* Hlmgr. and *Trinervitermes heimi* (Wasm.) attacking sugar-cane in Bihar, and the effect of treatment on soil fertility, were carried out in small and large plots in 1954–55 and in large ones in 1955–56. The insecticides were applied to the setts in the furrow at planting time in January at 0.5, 1 or 1.5 lb. in 20 lb. dust or 50 gals. emulsion spray per acre, and the cane was harvested a year later. In the first year, all treatments reduced infestation and increased germination and yield significantly, with no significant differences between them, and in the second, the same results were obtained for infestation and germination and similar though somewhat inconsistent ones for yield, and it appears that 0.5 lb. insecticide per acre would give satisfactory results. Soil fertility, determined from the carbon dioxide evolved after incubation for 96 hours, by a method that is described, was depressed after eight months but unaffected after 12 in the first year and unaffected or slightly stimulated in the second by both materials.

KAPOOR (M.S.). **Studies on the Bionomics and Control of *Bissetia steniellus* Hampson in the Punjab.**—*Indian J. Ent.* **19** (1957) pt. 2 pp. 132–143; pt. 3 pp. 181–192, 15 refs. New Delhi, 1957–58.

Bissetia steniella (Hmps.) [*cf. R.A.E.*, A **39** 429] is an important pest of sugar-cane in north-western India, and its bionomics and control were investigated in the Punjab in 1946–47 and 1949–50. The following is based largely on the author's summary of the results.

There were usually three overlapping generations of the moth-borer each year, with average life-cycles of 35,37 and 284 days, the larvae of the third generation hatching in September, overwintering in the lower stems, above or below ground level, and pupating in the following May or June. During June–September, the females deposited totals of 94–300 eggs each in clusters of 3–92 on the upper surfaces of the leaves over periods of 3–6 days, and the durations of the egg, larval and pupal stages averaged 6, 22 and 8 days, respectively. All larvae from an egg cluster entered the same cane and fed gregariously until the third moult, after which most of them migrated along the leaves and entered adjacent canes. Pupation took place in the stems.

Infestation resulted in the drying of the top leaves, and losses of 100, 59.4 and 19.5 per cent. in the length and 100, 64 and 38 per cent. in the weight of the canes were caused by the three generations, respectively. Chemical analysis of the juice from damaged canes showed losses of 17 and 29 per cent. total solids and sucrose, respectively, and an increase of 84 per cent. in the glucose content; recovery of unrefined sugar was reduced by 74 per cent. Five varieties of cane were comparatively resistant to attack, and ratoon crops were more resistant than freshly planted ones. Close planting, liberal manuring and irrigation favoured infestation. Heavy rainfall in winter and delayed and low rainfall in summer greatly reduced the population, and the reverse conditions favoured it; the pest was restricted to localities with high annual rainfall (above 20 in.).

Trichogramma minutum Ril. was the only parasite observed; it attacked 2–15 per cent. of the eggs in July–September, but gave no practical control, and artificial liberations of laboratory-reared examples proved ineffective. Cutting infested canes early in the season and uprooting and destroying stubble showing borer galleries immediately after harvest gave good control. Harvesting the crop early and cutting the canes low kept populations to a minimum, and soaking the setts in water for 12 hours before planting killed larvae hibernating in them.

DATTA GUPTA (A.K.). **Metabolism of synergised Pyrethrum by Insects.** —*Indian J. Ent.* **19** (1957) pt. 3 pp. 193–199, 9 graphs, 6 refs. New Delhi, 1958.

In the tests described, adults of three insects were exposed for 24 hours on filter paper impregnated with insecticidally equivalent concentrations of pyrethrum, alone or with piperonyl butoxide or a 1:1 mixture of this compound with sulfoxide [1,2-methylenedioxy-4-(2-(octylsulphinyl)propyl)benzene] as synergist. *Calandra granaria* (L.) was exposed to concentrations of 0.25, 0.354 and 0.5 per cent., *Tribolium castaneum* (Hbst.) to 0.25, 0.5 and 1 per cent. and *Callosobruchus chinensis* (L.) to 0.125, 0.25 and 0.5 per cent. pyrethrum or pyrethrum with synergist (1:6), and the insects were assayed against the same formulations and concentrations after a recovery period of 24 hours, to determine the extent to which the insecticides had been metabolised. The response selected was knockdown. An index of

unmetabolised insecticide was found by dividing the median-response concentration of insects initially treated with solvent only by that of insects initially treated with insecticide, and comparisons showed similar indices for pyrethrum alone and with either synergist.

A test in which pyrethrum and synergist were mixed in ratios of 1:1, 1:2, 1:3, 1:4 and 1:5 showed no significant differences in median-response concentrations, whichever insect or synergist was used.

SUBRAMANIAN (T.R.). **Description and Life-history of a new Weevil of the Genus *Protocylas* from Coimbatore.** — *Indian J. Ent.* **19** (1957) pt. 3 pp. 204–213, 3 figs., 1 ref. New Delhi, 1958.

Descriptions are given of all stages of *Protocylas coimbatorensis*, sp. n., a weevil that was found breeding in large numbers in the fruits of the wild *Ipomoea sepiaria* (probably its main food-plant) and sweet potato (*I. batatas*) at Coimbatore in December 1952; adults were also found on two ornamental creepers of the same genus. The adults are active, but rarely fly, and feed on the flowers and tender fruits. The eggs are deposited in the fruits, usually singly, and when 2–3 occur in the same fruit, only one develops. The larvae devour the contents of the fruit capsules and pupate within them. The egg, larval and pupal stages lasted 6–8, 18–23, and 8–10 days, respectively, males and females lived for 77–106 and 91–130 days with food and 3–8 and 4–8 days without, and females deposited 35–172 eggs each in a period of 11–87 days after a preoviposition period of 6–10 days. The weevil was present throughout the year at Coimbatore, but most numerous in January–April when *I. sepiaria* flowers profusely; 80 per cent. or more of the adults reared or collected were females. As sweet potato is propagated by means of the tubers and vines, the weevil is of little importance on the crop.

MEHRA (B.P.) & PURAKAYASTHA (B.K.). **Field Observations on a severe Outbreak of *Tessaratoma javanica* Thunberg, a sporadic Pest of Kusum (*Schleichera oleosa*) and preliminary Trials on its Control.** — *Indian J. Ent.* **19** (1957) pt. 3 pp. 214–216, 2 refs. New Delhi, 1958.

A severe outbreak of *Tessaratoma javanica* (Thnb.) occurred on *Schleichera oleosa* near Ranchi, Chota Nagpur, in the third week of July 1955 [*cf. R.A.E.*, A **45** 66]. The trees had been pruned in the first week of the month, and the infestation caused considerable delay in the appearance of new leaves and affected growth throughout the season. Adults of the Pentatomid were very numerous on shoots one month old and progressively less so as the age of the shoots increased. Males and females were about equally numerous, and eggs were laid on any available vegetation or on other materials. Collecting the bugs by means of hand nets gave the best control, but the use of smoke to make them fall on sticky cloths below the plant was effective on small trees in dry weather [*cf.* **45** 67]. Dusting with 5 per cent. BHC seemed to repel the bugs temporarily, and spraying with 0.6 per cent. wettable BHC or DDT kept them away for about ten days. Spraying with 1 pint 20 per cent. γ BHC emulsion concentrate in 8.5 gal. water or with kerosene emulsion killed the nymphs and adults, but the kerosene scorched the foliage; lime-sulphur sprays were ineffective and also caused scorching. Notes on various insects associated with *T. javanica* are appended.

PRADHAN (S.), JOTWANI (M.G.) & RAI (B.K.). **Relative Toxicity of some organo-phosphorus Insecticides to** *Lipaphis erysimi* **(Kalt.) (***Rhopalosiphum pseudobrassicae* **(Davis)) (Aphididae: Homoptera).** — *Indian J. Ent.* **19** (1957) pt. 3 pp. 217–220, 1 fig. New Delhi, 1958.

In further tests in India of the toxicity of phosphorus insecticides to *Rhopalosiphum pseudobrassicae* (Davis) (*Lipaphis erysimi*, auct.) [*cf. R.A.E.*, A **43** 186], shoots bearing approximately equal numbers of aphids were sprayed with different concentrations of insecticide in a Potter tower and examined for aphid mortality 48 hours later. The results were analysed to determine the LC50's, from which it was found that Systox [diethyl 2-(ethylthio)ethyl phosphorothioate (demeton)], malathion, diazinon [O,O-diethyl O-2-isopropyl-4-methyl-6-pyrimidinyl phosphorothioate], HETP [hexaethyl tetraphosphate] and Pestox [schradan] were 1.234, 0.887, 0.766, 0.249 and 0.118 times as toxic as parathion.

DAS (G.M.). **Preliminary Observations on the Leaf-rollers and Leaf-tiers of Tea, with special Reference to the Flush-worm,** *Cydia* **(***Enarmonia***)** *leucostoma* **Meyer in north-east India.** — *Proc. zool. Soc. Calcutta* **10** (1957) no. 2 pp. 107–120, 1 pl., 27 refs. Calcutta, 1958.

Cydia leucostoma (Meyr.) was a minor pest of tea in north-eastern India until 1956, when outbreaks occurred on estates at Cachar and Darjeeling; a similar increase had been observed in the south-west in 1955 [*cf. R.A.E.*, A **45** 464]. The bionomics of *C. leucostoma* and of other moths that roll or tie the leaves together were studied as a preliminary to investigations on the causes of the sudden rise in population. The damage caused by *C. leucostoma* [*cf.* **10** 282; **28** 202] is more serious than that due to the other pests, and infested shoots are rendered unusable. After feeding on the leaves of a bud for 3–4 weeks, the larva migrates down the shoot and pupates in the folded margin of an older leaf. The adult emerges after 11–12 days, and there are several generations per year. The larvae were parasitised by *Asympiesiella india* Gir. and an unidentified species, which together afforded 8 per cent. mortality in December–January. Wild species of *Camellia* and *Eurya* are alternative food-plants, and a heavy infestation of tea on one estate in Assam was associated with high populations on *Eurya* in the neighbouring jungle.

Information on *Gracillaria theivora* Wlsm. is given mainly from the literature [*cf.* **10** 281; **28** 202]; 46 per cent. of the larvae were parasitised by *A. india* and an undetermined parasite, which possibly accounts for the low incidence of this species. *Homona coffearia* (Nietn.) is also of little importance, but only one undetermined Dipterous parasite has so far been recorded from it. The egg, larval and pupal stages last 6–8, 26–27 and 6–8 days, respectively, in March–April. *Striglina glareola* (Feld.), which has not previously been recorded from the area, was occasionally found on side branches; the larva rolls a leaf progressively until it has eaten the greater part of it, and then moves to a fresh one, damaging in all about 3–4 leaves but usually restricting itself to the older ones. Its life-history is unknown. *Sylepta balteata* (F.), which is highly polyphagous, has been found in small numbers on tea since 1952. The eggs are laid singly on older leaves. The larva feeds within a rolled leaf, and draws other leaves into the roll as development proceeds; it pupates in the nest after about 24 days, and the pupal stage lasts about 14 days in March. *Synchalara* (*Agriophara*) *rhombota* (Meyr.) is of rare occurrence [*cf.* 8 530; 9 273], and severe infestation has been reported of recent years only in Assam in

January 1949. The eggs are laid singly on the bushes and hatch in 14–21 days in hot weather. The larva feeds within older leaves drawn over one another, and sometimes emerges to feed on the leaf margins or, rarely, on the bark of young shoots on pruned bushes. It becomes fully grown in 3–5 weeks and pupates in the soil or sometimes within the leaf-mass or in the forks of branches.

ARORA (G.L.) & PAJNI (H.R.). **Some Observations on the Biology and Oviposition of** *Bruchus analis* **F. (Bruchidae: Coleoptera).** — *Res. Bull. Panjab Univ.* (Zool.) no. 128 pp. 453–470, 1 pl., 3 graphs, 6 refs. Hoshiarpur, 1957.

The following is based mainly on the authors' summary. *Callosobruchus* (*Bruchus*) *analis* (F.) is a common pest of stored pulses at Hoshiarpur, in north-western India. It prefers *Phaseolus aconitifolius* and *P. aureus* (*radiatus*), and has up to nine generations a year. Observations on its bionomics, with special reference to oviposition, showed that the adults pair immediately after leaving the seeds in which they have developed and that the eggs are usually laid singly on the seeds, being fastened to them by means of a sticky fluid. The number of eggs laid per female ranged from 109 at 35° C. [95° F.] and 90 per cent. relative humidity to 11 at 20° C. [68° F.] and 50 per cent. relative humidity, the oviposition period lasting 2–17 days. The maximum number laid in 24 hours was 47, and oviposition was not stimulated by repeated pairing.

DAVATCHI (G.A.). **Étude biologique de la faune entomologique des** *Pistacia* **sauvages et cultivés.** — *Rev. Path. vég.* 37 fasc. 1 pp. 1–166, 128 figs., 7½ pp. refs. Paris, 1958.

This monographic account of the insects and mites associated with *Pistacia* spp. in western Asia and the Mediterranean area, including parts of the Soviet Union, is based partly on ten years' observations in Persia and southern France and partly on the literature. The world distribution, ecology and cultivation of *Pistacia* spp. are discussed. The pistachio (*P. vera*) is alone of major economic interest, though other species have local uses. About 150 species of insects are listed, including predators and parasites, and the bionomics of many of them, especially the gall-forming aphids (Fordinae), are described in detail, but relatively few occur on *P. vera* [*cf. R.A.E.*, A 36 385–386]. Nevertheless, infestation is estimated to reduce the nut crop by more than 50 per cent. in Persia, where there were some 5 million trees in 1956. The damage may be caused by one or more of about 20 species, the relative importance of which varies from district to district, probably because of migration from other species of *Pistacia* in particular areas. At Kazvin, *Idiocerus stäli* Fieb. was the dominant pest for many years, destroying most of the fruits, but it was controlled by the large-scale use of DDT. The resulting increase in available fruits permitted an increase in *Eurytoma plotnikovi* Nikol'skaya [*cf.* 45 42], which, since it develops in the fruits, was protected from the insecticide. Another result of the use of DDT was the destruction of the parasites of *Lepidosaphes pistaciae* Arkh., which enabled the scale to reach damaging numbers. Similar changes in pest status occurred in localities in south-eastern Persia, where control of *I. stäli* on *P. vera* was followed by an increase in the Psyllid, *Agonoscena targionii* (Licht.), which is not susceptible to chlorinated insecticides.

The pests of *P. vera* of which the bionomics are described [*cf.* **36** 386] are *I. stäli*, *A. targionii*, *Anapulvinaria* (*Pulvinaria*) *pistaciae* (Bodenh.) [*cf.* **34** 16], *Recurvaria pistaciicola* Danil. [**45** 424], *Thaumetopoea solitaria* (Freyer), *Capnodis cariosa hauseri* (Obenb.) [*cf.* **34** 369, etc.], *Anthaxia judinae* Stepanov, *Hylesinus* (*Chaetoptelius*) *vestitus* (M.&R.) [*cf.* **46** 238], and *Estenoborus perrisi* (Chap.); all occur in Persia, and most of them also in other countries. Modern insecticides are suggested for use against most of the pests [*cf.* **39** 205].

GRISON (P.). **Les facteurs alimentaires de la fécondité chez le doryphore (*Leptinotarsa decemlineata* Say) (Col. Chrysomelidae).** — *Ann. Epiphyt.* **8** no. 3 pp. 305—381, 23 figs., 6 pp. refs. Paris, 1957.

The effects of the quantity and quality of the food ingested by adult females of *Leptinotarsa decemlineata* (Say) on their fecundity were studied in the laboratory in northern France during 1946—55. The experiments were carried out with mating pairs or fertilised females, restricted for 10—20 days to single shoots of potato in individual cages. The foliage was renewed and the eggs counted daily, and samples of the leaves were analysed in some tests. In some series, the leaves were supplemented with a nutrient solution; replacement of the foliage by disks of elder pith coated with nutrients gave unsatisfactory results. The average number of eggs laid per day per female was taken as an index of fecundity. The results were examined statistically, as there was considerable individual variation, and it was found that a mean of 353 eggs per female was laid in the course of an average life of 42 days after diapause. The diapause follows a maturation phase, during which the beetles feed avidly on potato plants for about 12 days and become sexually mature, and in northern France it lasts from October to April. The development of oocytes is arrested during this period [*cf. R.A.E.*, A **35** 311]. The reproductive phase occurs in April—August and oviposition is usually preceded by feeding for several days. Before the diapause, 50 per cent. of the ingested dry matter was retained by males and 57 per cent. by females, as compared with 46 and 50 per cent., respectively, after it.

The number of eggs laid and the number laid per day increased with temperature up to 21.7 and 28.7° C. [71.06 and 83.66° F.], respectively, after which they dropped very rapidly. The influence of humidity was not directly ascertained [*cf.* **43** 121], but experiments on the effects of light and darkness on fecundity at 25° C. showed that about seven times as many eggs were laid at 68 per cent. relative humidity as at 100 per cent. The number laid in constant darkness was about half that laid under an illumination of 1,000 lux. Under constant white light there was no difference between the numbers laid between 6 p.m. and 8 a.m. and between 8 a.m. and 6 p.m., but under constant red light about two-thirds of the daily total was laid between 8 a.m. and 6 p.m. A direct correlation was established between the quantity of food eaten and fecundity [*cf.* **43** 121], save at the lowest levels of ingestion, where a threshold value for egg development and oviposition was found. Individual variation was very marked. Females allowed unlimited food for 20 days from 19th May laid an average of 38.9 eggs each per day and ate 768 sq. mm. of young leaf; those restricted to 4 sq. cm. of leaf per day ate 352 sq. mm. each and laid an average of 3.6 eggs per day, and oviposition ceased when only 1 sq. cm. was provided each day. In two tests begun on 9th June, both fecundity and food intake were lessened, though the food supply was not limited, the mean daily numbers of eggs per female being 13.9 and 20 at daily feeding rates of 400

and 590 sq. mm., respectively.

The effects of the total nitrogen and sugar contents of the leaves and the carbon-nitrogen ratio were studied in three seasons by comparing the numbers of eggs laid per female on potato plants grown under different conditions. The fecundity index was greatest (7.1—13.3) when the plants were grown on plateau clay in full sunlight, slightly less (6.5—11) on leaf-mould in sunlight, 3.2—10.6 on clay under light shade, and least (1.2—9.1) on leaf-mould under shade; this order did not correspond with the carbon-nitrogen ratios of the foliage, which were greatest for the leaf-mould in full sunlight and least for the shaded clay. Significant differences in the chemical composition of the leaves as a result of photosynthesis were shown by sampling at 9 a.m. and 6 p.m. The quantities of free reducing sugars, total sugars and total nitrogen all increased later in the day, as also did the carbon-nitrogen ratio, but the fecundity index decreased for beetles fed on such leaves, and an inverse relation was demonstrated between fecundity and the glucose content of the leaves. The physiological age of the leaf has a great effect on fecundity [*cf.* 25 460]; an extreme case was observed in 1954, when the index was 14.8 on young leaves sampled at 9 a.m. and 0 on older leaves sampled at 6 p.m. For the purposes of the experiments described, young leaves were defined as those still in the course of development, occupying the 4th—6th positions below the terminal bud, and mature leaves as those that had reached their maximum surface area and were situated either at the base of plants 4—6 weeks old or medially on the stems of older plants. Mature leaves were usually taken during the flowering period, and representative results are given from experiments carried out over all the seasons. The fecundity index of females fed on young leaves was generally at least twice that of females fed on mature ones. When females were fed for five days on young leaves and were then transferred to a diet of mature leaves, the index dropped to 0 after 15 days, but rose to its original level within three days if the insects were again provided with young leaves. Earlier work had indicated that the nature of the food eaten before diapause had no effect on fecundity, and a test in 1949 showed that females that fed on mature leaves before diapause and on young leaves afterwards were as fecund as those that fed throughout on young leaves. In 1952, batches of ten females were fed between 20th June and 26th July on young leaves collected from young plants, a fresh planting being used each week, on young leaves taken always from the same planting, on mature leaves collected from a single planting, or on young leaves, as in the first series, but with feeding restricted to two hours each day. The mean fecundity indices were 23.8, 20.4, 5 and 2.1, respectively, and the average areas of leaf consumed were 405, 283, 217 and 91 sq. mm. per day. The areas of leaf consumed and the number of eggs laid usually decreased during the tests, but there was a temporary rise in fecundity during the second week in the first two series.

Investigations on the relation between fecundity and the chemical composition of the leaves, carried out in 1949 and 1953, were restricted to an examination of the part played by the carbon-nitrogen ratio. Conflicting results were obtained from comparisons of the fecundity index with analysed carbon-nitrogen figures for healthy or virus-infected plants. An index of 19.4 was recorded after females had fed for 13 days on young leaves containing 4.5 per cent. total sugars and 8 per cent. total nitrogen (carbon-nitrogen ratio 0.56), as compared with an index of 5.5 when the food consisted of etiolated leaves containing 3.4 per cent. total sugars and 7.8 per cent. nitrogen (carbon-nitrogen ratio 0.44), but in another test in which leaves infected with virus had a carbon-nitrogen ratio of 1.04 as compared with 1.28 in healthy plants, the indices were 24.9 and 21.7, respectively.

Of the total available nitrogen, 40—75 per cent. was retained by feeding females, varying with plant variety. Incomplete tests with supplemented diets gave inconclusive results of no statistical significance, although there were indications that the addition of casein as a source of nitrogen increased fecundity when the basic diet was deficient in it. Supplemented feeding with saccharose, starch, peptone, nucleic acid and dried extract of brewer's yeast, tocopherol and mixtures of amino acids appeared neither to inhibit nor to stimulate fecundity.

Earlier work had shown that fecundity was increased by supplementing potato leaves with a 2 per cent. emulsion of lecithins and a special study was therefore made of the variations in cholinic lipids in the insect and in the food-plant. Contents of total choline, expressed as mg. per g. fresh weight, were established for all stages of development of the insect at different periods. The eggs contained 1.03 mg. per g. in the spring, the larvae 0.56—0.72 mg. from July to September and the pupae 0.59 mg. in July. Adult females contained 0.875—1.235 mg. per g. before diapause, the amount in general increasing with time, 0.83—0.432 mg. during diapause, when it decreased progressively, and 1.03—1.54 mg. during the reproductive phase in June—July. Choline levels in adult males followed a similar pattern, but were lower than in females (0.755—1.19, 0.61—0.535 and 0.87—1.38 mg. before, during and after diapause, although the amounts of total fatty acids were higher in males than in females. Levels of total choline in potato leaves decreased from an initial maximum of 0.21 mg. per g. fresh weight in young leaves in May to 0.07 mg. in mature, mildewed leaves at the beginning of August, with variations according to the percentage of dry matter present. The total choline content of adults in the reproductive phase was enhanced when they were fed for two days on leaves supplemented with an aqueous emulsion of lecithin containing 3.66 mg. total choline per cc., the level being increased in females from 1.45 to 1.72 and in males from 1.22 to 1.44 mg. per g. Almost all the choline present in the food was retained by freshly emerged adults, and the uptake of choline in 24 hours was found in subsequent experiments to be 0.16—0.22 mg. per individual, but only 53 per cent. was retained by adults feeding after hibernation. The cholinic substances of potato foliage probably have more value than added lecithins. Feeding tests in 1953—54 with several varieties of potato showed that the fecundity index was directly correlated with the content of total choline in the leaves, but not with the carbon-nitrogen ratio. Several experiments are described in which the food was supplemented with lecithins to increase the amount of choline available to the insects; although the results were not always satisfactory, none showed a negative effect on fecundity and all were at least as significant as those obtained in the tests with nitrogenous supplements. The effects of the various diets on ovarian development are briefly described and illustrated.

TEMPANY (Sir H.) & GRIST (D.H.). **An Introduction to Tropical Agriculture.** — 9 x 6 in., xvi + 347 pp., 12 pls. (4 col.), 6 figs., 10½ pp. refs. London, &c., Longmans, Green & Co., 1958. Price £2.

This book is concerned more with the factors, climatic and other, that have determined the pattern of agricultural development in tropical countries, particularly those within the British Commonwealth, than with the cultivation of individual crops. The three main sections into which it is divided are devoted to the tropical background, agricultural practice in the tropics, and economic considerations, and the second of these includes a short chapter (pp. 183—204) on pests and diseases, in which reference is made to some of the more important insect pests of tropical crops and means

available for their control, and also to virus diseases, some of which are transmitted by insects. Insect pests of stored products and measures against them are noticed in another chapter, and mention is also made of the use of insects to destroy noxious weeds.

CACHAN (P.). **L'Hispidae mineur *Coelaenomenodera elaeidis* Maul. parasite du palmier à huile dans la zone guinéenne.** — *Agron. trop.* **12** no. 5 pp. 610—632, 18 figs., 12 refs. Nogent-sur-Marne, 1957. (With Summaries in English & Spanish.)

Coelaenomenodera elaeidis Mlk. is indigenous in the oil-palm belt of the Guinea area, and occasional outbreaks of it have been reported on oil palm (*Elaeis guineënsis*) since 1909 [*cf. R.A.E.*, A 8 118]. These have usually been of little importance, but a severe outbreak began in an extensive area of natural growth near Porto-Novo, Dahomey, in November—December 1955. Investigations on the Hispid were made, and the results are compared with those of similar observations made in an infested plantation at La Mé, in the Ivory Coast, from 1951 onwards.

The author describes the life-history of *C. elaeidis* and the damage that it causes, which is due mainly to the mining of the leaves by the larvae [*cf.* 13 421]. In both areas, there appeared to be three generations a year, with life-cycles of about three months and emergence of adults in April—May, July—August and November—December, but overlapping resulted in the presence of larvae, pupae and adults at all times of year in an established infestation. Surveys made near Porto-Novo in November—December 1956 showed that the attack was increasing in some places, but decreasing or remaining stationary in others, so that it was impossible to determine the status of the outbreak; populations of up to 800 larvae per tree were counted, and no parasites were found. At La Mé, populations varied from 5—10 per tree in normal areas to more than 500 in the outbreak area, and records from 1947 to 1956 showed that population increases occurred 12—18 months after abnormal variations in climate, particularly reductions in temperature. Observations at Porto-Novo showed a similar relation, and unusually low mean temperatures during the hottest months (December—April) since 1949 are considered to be the main cause of the outbreak there.

Among possible control measures, systematic pruning reduces production for two years and is inadvisable, as climatic changes may reduce the outbreak at any time. Spraying or dusting with BHC by aeroplane is effective only at times of adult emergence, and several insecticides applied in atomised emulsion sprays by ground machine at La Mé gave little or no mortality of the larvae. It is considered advisable, therefore, to determine the times at which adults will be most numerous, particularly in the dry season, and to apply sprays then. Meteorological data and the regular examination of leaf samples can be used to forecast the time and distribution of outbreaks in plantations, as at La Mé, where spraying with dieldrin from ground machines killed up to 540 adults per tree, but indiscriminate treatment is undesirable as the spray kills parasites and predators. In natural growth, as at Porto-Novo, where there are probably more than six million trees over an area of about 300 sq. miles, the density and age of the trees are very variable, food crops are grown under them and water is scarce, both pruning and insecticidal applications over the whole of the area are impossible. Forming barriers to prevent the spread of infestation by spraying the trees along tracks with BHC or dieldrin, applied from ground machines against the adults, is suggested. Cut leaves should be burnt at once; complete combustion is not necessary, as a relatively small increase in temperature destroys all the larvae. Burning the vegetation under the trees is also beneficial.

GALICHET (P.F.). **Les principaux parasites du cotonnier au Tchad.** — *Cot. et. Fibr. trop.* **12** fasc. 3 pp. 357–406, 31 figs., 21 refs. Paris, 1957.

Notes on the appearance, bionomics and control of the more important insects and other arthropods found attacking cotton in the Chad Territory of French Equatorial Africa are followed by a key permitting their identification from the type of damage caused.

LEFKOVITCH (L.P.). **Further Records of Laemophloeinae (Col., Cucujidae) in Stored Products.** — *Ent. mon. Mag.* 93 no. 1121 p. 239, 3 refs. London, 1957. **A new Genus and Species of Laemophloeinae (Col., Cucujidae) from Africa.** — *T. c.* no. 1123 pp. 271–273, 13 figs., 5 refs. 1958.

It is stated in the first paper than an undetermined Cucujid taken in ships at British ports three times on Malayan illipe nuts (*Shorea stenoptera*) from Sarawak and North Borneo and once on desiccated coconut from Ceylon during investigations described in an earlier paper [*R.A.E.*, A **46** 42] has been identified as *Laemophloeus* (*sens. lat.*) *divaricatus* Grouv. *L. glabriculus* Grouv. was found on broken rice originating from Burma in 1948 and 1956 and also on dunnage originating from Nigeria in 1957; this species was originally described from Sumatra, but it appears unlikely that the West African infestation arose from a population already in the ship. Other species recorded from stored products are *Leptophloeus janeti* (Grouv.), found infesting cacao in Ghana in February of 1956 and 1957, and one referred to as *Planolestes cornutus* (Grouv.). In the second paper, the latter species is transferred from *Laemophloeus* to *Planolestes*, gen. n., which is erected for *P. laevicornis*, sp. n. (the type), recorded from twigs of mimosa thorn [*Acacia horrida*] in South Africa, and two other species. *P. cornutus*, which was originally described from Madagascar, was found infesting stored maize in Uganda in February 1956 and green gram (*Phaseolus mungo*) in Ghana in September and November 1955.

AYOUTANTIS (A.J.), KOURMOUSSIS (A.) & PÉLÉKASSIS (C.). **Rapport sur les travaux expérimentaux de lutte contre le *Dacus* avec les esters phosphoriques en 1955.** [*In Greek.*] — 182 pp. 1 map. Athens, Dir. Phytopath., Dir. gén. Agric., 1956. (With a Summary in French.)

The following is based on the authors' summary. The testing of organic phosphorus insecticides for the control of *Dacus oleae* (Gmel.) on olive in Greece was begun in 1953 [*R.A.E.*, A **43** 173]. It was continued in 1954, but the occurrence of large insecticide residues in the harvested fruits rendered the results nugatory. Further experiments with reduced concentrations were made in 1955, and it was then found that sprays of 0.015 per cent. parathion, diazinon [O,O-diethyl O-2-isopropyl-4-methyl-6-pyrimidinyl phosphorothioate] or Chlorthion [O,O-dimethyl O-3-chloro-4-nitrophenyl phosphorothioate], applied as often as required by the course of the attack, gave good control in several districts on varieties having small fruits, but were less satisfactory or ineffective on those having medium-sized or large ones, in which the larvae were presumably protected from the effects of the insecticides. In Corfu, on a medium-sized variety, two applications of diazinon at 0.015 or 0.025 per cent. followed by one at 0.06–0.1 per cent. gave very good results, with residues in the oil of little more than

1 part per million [*cf.* **46** 467]. Diazinon was in general superior to parathion, and Chlorthion, which is less toxic than the latter to mammals, was promising, but left large residues.

KEEN (F.P.). **Cone and Seed Insects of western Forest Trees.** — *Tech. Bull. U. S. Dep. Agric.* no. 1169, vi + 168 pp., 57 figs., 80 refs. Washington, D.C., 1958.

Investigations on the insects that injure the cones or seeds of forest trees (mostly conifers) in the western United States were carried out in 1912–17, but little use was made of the results until nearly 40 years later, when the development of methods of applying sprays from aircraft had rendered control measures practicable. This bulletin contains a list of the trees concerned, showing the insects that injure or are otherwise associated with their cones or seeds, including parasites and predators, followed by one of the insects and their enemies, with notes on the trees concerned, morphology, distribution and habits. Keys are included for the species of some genera.

ÉDEL'MAN (N.M.). **Ways of using the Food Specialisation of *Lymantria dispar* L. as a Basis for Preventive Measures.** [*In Russian.*] — *Zool. Zh.* **36** pt. 3 pp. 408–420, 16 refs. Moscow, 1957. (With a Summary in English.)

From a study of the food-plant relations of *Lymantria dispar* (L.) in the south of the Soviet Union [*cf. R.A.E.*, A **46** 68], it is concluded that damage to oak, which is preferred, can be reduced in shelter belts to a greater or less degree by interplanting with trees that are not infested, although eggs may be laid on them, or that delay the development of the larvae. This also reduces infestation by other pests.

PAPERS NOTICED BY TITLE ONLY.

GIANG (P.A.) & SCHECHTER (M.S.). **Colorimetric Method for Estimation of Guthion** [O,O-dimethyl S-(4-oxo-benzotriazino-3-methyl) phosphorodithioate] **Residues in Cottonseeds and Cottonseed Oil.** — *J. agric. Fd. Chem.* **6** no. 11 pp. 845–848, 2 figs., 19 refs. Easton, Pa., 1958.

BRINDLEY (T.A.), CHAMBERLIN (J.C.) & SCHOPP (R.). **The Pea Weevil** [*Bruchus pisorum* (L.) in U.S.A.] **and Methods for its Control.** — *Fmrs' Bull. U.S. Dep. Agric.* no. 1971 (revd.), 24 pp., 13 figs. Washington, D.C., 1958. [*Cf. R.A.E.*, A **35** 232.]

HICKS (E.A.). **Check-list and Bibliography on the Occurrence of Insects in Birds' Nests.** — 9¼ x 6¼ in., 681 pp., many refs. Ames, Iowa, Iowa St. Coll. Pr. [1959]. Price $8.50.

CROMROY (H.L.). **A preliminary Survey of the Plant Mites of Puerto Rico** [including new species]. — *J. Agric. Univ. P.R.* **42** no. 2 pp. 39–144, 54 figs., 235 refs. Río Piedras, P.R., 1958. (With a Summary in Spanish.)

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